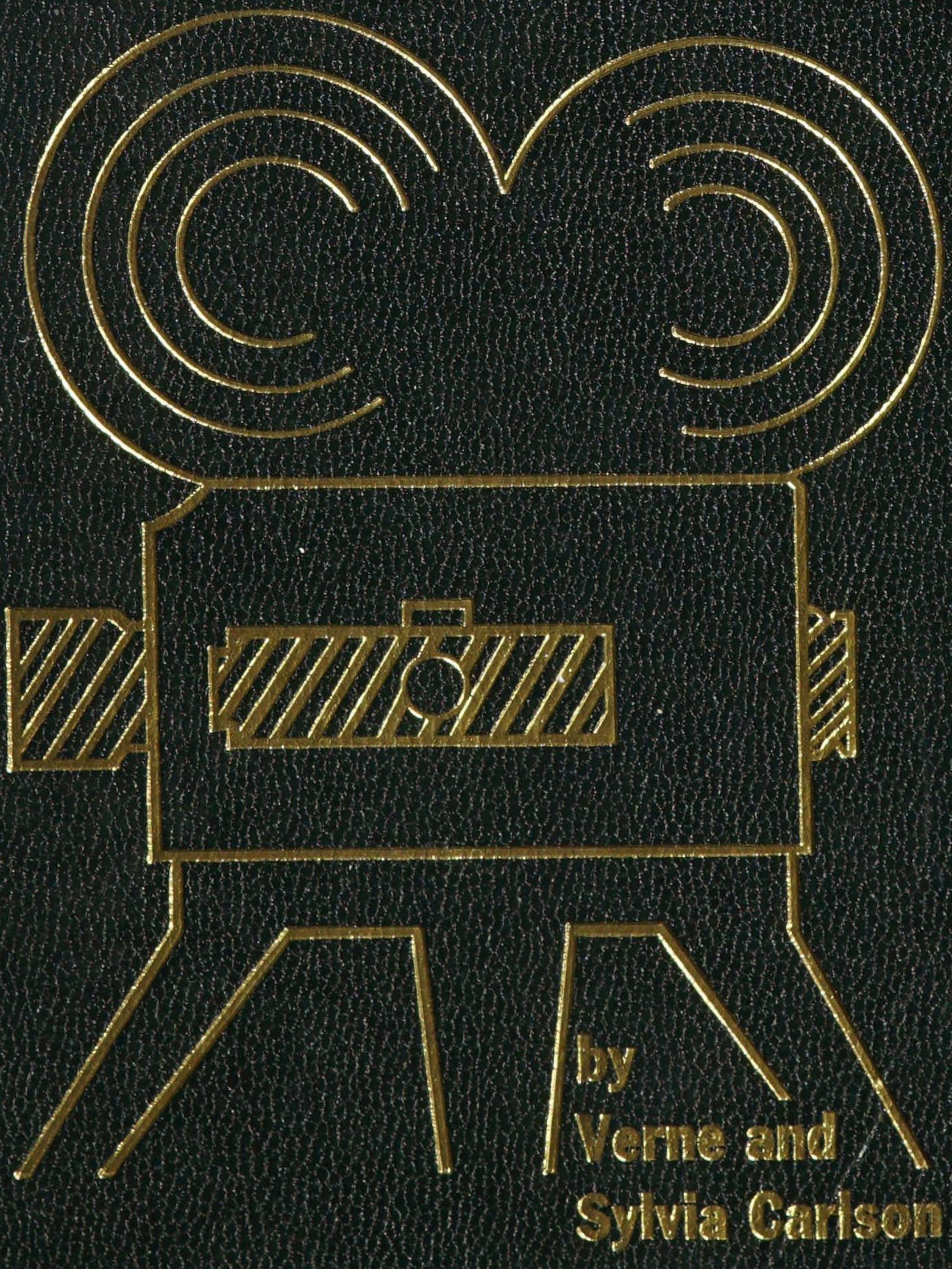
PROFESSIONAL 16/35mm CAMERAMAN'S HANDBOOK



by
Verne and
Sylvia Carlson

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Professional
16/35mm Cameraman's
Handbook

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16/35mm Cameraman's Handbook

by

Verne and Sylvia Carlson

AMPHOTO
American Photographic
Book Publishing Co., Inc.
NEW YORK

To Herbert Aller, in appreciation for his long and devoted service to IATSE, Local 659 (Cameramen).

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Foreword

Cameramen have long had a need for a book that would provide practical assistance for working with a variety of motion picture cameras and accessories. The information given here is intended to fulfill that need. This book is for use on the job as a practical "how to" guide for assembly, threading, and troubleshooting the equipment involved. The range of material covered includes 35mm cameras and accessories, 16mm cameras and accessories, and procedural information which will aid the user of motion picture equipment.

We believe that the material will be of value to professionals as well as students who may be confronted with unfamiliar equipment and procedures.

It is not our intention to favor or "sell" any item mentioned.

In the course of his 21 years in the film industry, Verne Carlson has had the good fortune to work with many talented cameramen who generously shared their knowledge and expertise with him. He believes the way to repay and thank those who helped him is to pass along that "hand-up" by sharing his experiences also. We sincerely hope this work will accomplish that purpose.

Sylvia E. Carlson

Acknowledgments

A note of thanks to the following people for extensive assistance in checking and verifying the technical data in this book: Dr. Robert Richter, Arnold & Richter K. G.; Victor James, Arriflex Corporation of America; Peter Waldeck, Bach Auricon, Inc.; Dan Tucker, Beckman & Whitley, Inc.; Jean-Pierre Carson, Eclair Corporation of America; Louis Capotosto, J. A. Maurer, Inc.; R. Bruce Hill, Jim Johnson, Mitchell Camera Corporation; Chadwell O'Connor, O'Connor Engineering Laboratories; George Worrall, Worrall Camera Company; Thor Lovoos, Mark Armistead, Inc.; Jack Birns, Birns & Sawyer, Inc.; Carl Porcello, F&B/Ceco, Inc.; Grant Loucks, Gordon Enterprises, Inc.; William Herndon, Raymond Eynard, Agfa-Gevaert, Inc.; Jack Goetz, Consolidated Film Industries, Inc.; Ralph Westfall, Ray Grant, Eastman Kodak, Inc.; W. R. Holm, E.I. Dupont de Nemours, Inc.; John L. Forrest, G. Stark, GAF Corporation; Jack Blencowe, Ilford, Inc.; William Widmayer, Columbia Pictures Corporation; Maurice Schoenfeld, United Press Newsfilm.

And, of course, my deepest appreciation and thanks to the following Cameramen who contributed their time and suggestions to the compilation of this book: Ken Allen; Leo Diner; James B. Drought; David L. Quaid; and Rexford Metz. A special acknowledgment to Gerald Slick who was sometime typist, critic, and arbitrator for a husband–wife writing team, and whose often repeated admonition, "Elementary to a pro, perhaps, but what about the novice?" proved to be invaluable.

A special note of thanks to Jack Smith for the literary guidance and helpful suggestions that "rounded out" the book.

And last but not least, I wish to thank the coauthor, whose influence on my life, as well as on the book, has made it all worth while.

VERNE CARLSON

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Camera Equipment

Arriflex: Arnold & Richter K.G.; 89, Türkenstrasse; 8 München 13; West Germany. Arriflex Corporation of America; 25-20 Brooklyn–Queens Expressway West; Woodside, New York 11377.

Auricon: Bach Auricon, Inc.; 6950 Romaine Street; Hollywood, Calif. 90038.

Beckman & Whitley: Beckman & Whitley; 441 Whisman Road; Mountain View, Calif. 94040.

Eclair: Eclair International Diffusion; 12, Rue Gaillon; Paris 2e, France. Eclair Corporation of America; 7262 Melrose Avenue; Los Angeles, Calif. 90046.

Kodak Reflex: Eastman Kodak Company; 343 State Street; Rochester, N. Y. 14650.

Maurer: J. A. Maurer, Inc.; 37-01 31st Street; Long Island City, New York 11101.

Mitchell: Mitchell Camera Corporation; 666 West Harvard Street; Glendale, Calif. 91204.

O'Connor Fluid Head: O'Connor Engineering Laboratories; 385 Green Street; Pasadena, Calif. 91101.

Worral Geared Hd: Worral Camera Company; 5659 Selmarine Drive; Culver City, Calif.

Film

Agfa-Gevaert Film: Agfa-Gevaert, Inc.; Mortsel-Antwerp, Belgium. Agfa-Gevaert, Inc.; 275 North Street; Teterboro, N. J. 07608.

Dupont Film: E.I. Dupont de Nemours & Co., Inc.; Wilmington, Del. 19868.

Eastman Film: Eastman Kodak Company; 343 State Street; Rochester, N. Y. 14650.

GAF (Ansco) Film: GAF Corporation; Binghamton, N. Y. 13902.

Ilford Film: Ilford, Inc.; 201/203 Wardour Street; London, W. 1, England. Ilford, Inc.; 37 West 65th Street; New York 10023.

Lenses

Angenieux Lenses: ETS Angenieux; 34 Blvd Haussmann; Paris 9, France. Angenieux Corporation of America; 440 Merrick Road; Oceanside, New York 11572.

Berthiot (Pan Cinor) Lenses: Benoist Berthiot Optical; 11 Blvd Sebastopol; Paris 1, France. Albion Optical Company; 260 N. Rt. 303; West Nyack, N. Y. 10994.

Century Lenses: Century Precision Optics; 10659 Burbank Blvd.; N. Hollywood, Calif. 91601.

Elgeet Lenses: Management & Technology, Inc. (Elgeet Division); 4225 West Henrietta Road; Rochester, N. Y. 14623.

Paillard Lenses: Paillard, S.A.; 1450 Ste. Croix, V.D.; Switzerland. Paillard, Inc. (Kern Optical Products); 1900 Lower Road; Linden, N. J. 07036.

Canon Lenses: Canon Camera Co., Inc.; 30-2, 3-Chome, Shimomaru Ko, OTA-KU; Tokyo, Japan. Canon, USA, Inc.; 6410 Queens Blvd.; Woodside, New York 11377.

Schneider Lenses: J. Schneider & Co.; Optische Werke; 6550 Bad-Kreuznach, Postfach 947; West Germany. Burleigh Brooks, Inc.; 44 Burlews Court, Hackensack, N. J. 07601.

Zeiss Lenses: Zeiss Ikon A.G.; Dornhalden Strasse 5; 7000 Stuttgart; West Germany. Zeiss Ikon-Voigtlander, Inc.; 444 Fifth Avenue, New York 10018.

How to Use this Book

This book is divided into two sections. The first section covers functions, methods, and procedures important to the working Cameraman. The second section covers 17 widely used production cameras and related equipment.

In the first section, each chapter is titled by general category; a numbered heading within the chapter refers to a certain aspect of the category. A numbered subheading with a letter added emphasizes a detail within the heading. Further particulars within the subheading are *italicized*. For example:

Category:	*Chapter 6:* "On The Job Procedures"
Heading:	**6.1 PRIOR TO SHOOTING**
Subheading:	**6.1a Preshooting inventory**
	6.1b Setting up
	6.1c Film scratch test
	6.1d "Hair check"

In the second section, chapters are titled by camera manufacturer. A numbered heading within the chapter refers to a particular camera *model* fabricated by that manufacturer. A numbered subheading with a letter added emphasizes a *component* of that camera model. Further particulars of parts that comprise the components are *italicized* within the text. For example:

Manufacturer:	*Chapter 16:* Mitchell Cameras, Magazines, Blimps, and Accessories
Heading:	**16.1 MITCHELL 35mm STANDARD/ HIGH-SPEED CAMERA**
Subheading:	**16.1a Base**
	16.1b Rackover
	16.1c Focusing tube
	16.1d Motors

Throughout the text bold type WARNINGS, CAUTIONS, and NOTES following the explanatory body provide safeguards relating to the preceding subject.

It must be remembered in using this handbook that all mechanical instructions are given from the Operator's point of view—as he stands in back of the camera in the "shooting position." Therefore, some parts and components on cameras (especially turrets) might seem to be found in a position opposite from the written instruction in the text. For example:

Turret Release: At the lower right.

When *facing* the turret (the obvious position to work on it), the release lever will be at the lower left. But by mentally orientating oneself to the Operator's point of view (standing in *back* of the camera), the lever will be at the lower right as per the instruction. It was necessary to base everything from the Operator's point of view to maintain consistency in instructions as to left, right, forward, and rear positions of the individual parts of the components.

Because the data and procedures presented here are the most efficient methods known to and tested by the author on the sound stages in major production centers, the information may in some instances differ from manufacturer's engineering data and procedural recommendations; instructions have been included which cannot be found in any other manual.

Introduction

Five or six years ago when an Assistant Director was ordering equipment from one of the professional camera rental houses for an exterior location day, his job was quite simple. He merely picked up the telephone, ordered a camera with a standard complement of lenses, which was composed of the 40mm, 50mm, 75mm, and 100mm lenses. All that was left to do was to meet the crew and actors the following day, and bus them to the location where the job would be photographed with the 40mm, 50mm, and 75mm lenses. No one ever used the 100mm lens: "flattened things out too much." Not so long ago a Cinematographer who traveled with a hand-held camera in addition to the "camera with the standard complement of lenses" was considered a little weird, to say the least.

Today, it is a bold Assistant Director indeed, who would order camera equipment without first consulting the Cinematographer. The camera is no longer a passive observer—it has increasingly become a part of the action. Many Directors now use the camera as a lecturer would use a pointer, with the zoom lens continuously expanding or contracting the frame in order to underline or highlight an important action or to place emphasis on a key prop. Now even the much maligned 100mm lens which "flattened things out too much" has given way to the daily use of lenses in the 400mm, 600mm, and 1000mm class. Lenses serve a greater purpose now than just recording action. The Director and Cinematographer choose a lens with a perspective which will permit the set or environmental elements to dominate the action; conversely, a lens with the opposite perspective is selected to permit the action to dominate the set elements or background. The flattening effect of the longer focal-length lenses and their attendant limited depth of field, combined with present-day zone-focusing techniques, has made it possible for the Director to shift dominance from element to element, from person to person, from foreground to background in one continuous take through shifting focus from plane to plane as the action develops.

Since more and more equipment is arriving on the market each

year, it has become increasingly important for the working technician to keep abreast of the proper application, maintenance, adjustment, and field repair of the myriad of equipment used on even the most modest film project.

Most errors "on the set" are visible almost immediately—when committed by crew members other than the Assistant Cameraman. For example, if an Electrician forgets to illuminate a "kicker" light it is visible when the subject moves into position; if a Grip pushes the camera dolly at the wrong speed the error is immediately visible; a Soundman can "play back" his takes immediately. No real harm is done by any of these people. However, when the Assistant Cameraman does not function properly the result of his mistake is invisible . . . until the film is projected onto the screen.

Many Producers and Assistant Directors forget that the Assistant Cameraman is the only man on the set who can "kill" the job. If he loads his magazines improperly, the job is dead. If his follow-focus moves are bad, the job is dead. If he mounts a zoom lens incorrectly, it will not be known until the laboratory calls—tomorrow. If the bookkeeping of his camera reports or his instructions to the laboratory are in error, a reshoot would probably have to be scheduled.

In a more perfect world the Assistant Cameraman would never be rushed by the production people, since a resultant and inadvertent invisible error by him could be disastrous. He must be aware that when he is overlong at reloading, doing his paperwork or any one of the hundreds of separate functions he performs daily, he is holding up the progress of the company. It is his responsibility to his profession to develop a high degree of efficiency, briskness of manner, and to avoid unnecessary delay.

The Director of Photography is responsible for the photographic integrity of the film. The Assistant Cameraman is responsible to the Director of Photography and for the proper care and maintenance of the equipment on the set. He must never leave his camera unmanned for any reason. His Dolly Grip, or some other responsible person, must have the camera under constant observation so that if the camera is hit by a moving set or tampered with by some unauthorized person in his absence, he can take measures to correct the condition.

Contemporary cinematography not only demands a much broader knowledge and greater skill from the Director and Cinematographer, it also places an incredible burden on the Assistant Cameraman. He must not only be thoroughly familiar with the "camera with the standard complement of lenses," he must also be an expert with a fantastic array of specialized equipment now in daily use and know the many complicated procedures so important to his work.

The overworked, harassed Assistant Cameraman, in-plant, or Documentary Cameraman finally has, in the *Professional 16/35mm Cameraman's Handbook*," a "bible" in which can be found guidance in the distillate of Verne Carlson's professional experience as a Hollywood Assistant Cameraman, Camera Operator, and Director of Photography.

In this volume, Mr. Carlson covers all phases of the Assistant Cameraman's responsibility, from loading room procedures to the most up-to-date information on the most advanced equipment and techniques.

A most vitally needed book; I will never be without a copy in my meter case.

DAVID L. QUAID

David L. Quaid started his film career in 1940. His numerous awards in cinematography range from the Legion of Merit and Bronze Star for filming Merrill's *Marauders* in wartime Burma, to the distinction of being the only Cameraman to win three Best Cinematography Awards at the American TV Festival (1964, 1966, 1968). A Director of Photography of documentaries, commercials, and feature films, at present David L. Quaid is President of his own production company, as well as an Instructor in Motion Picture Production at the School of Visual Arts, New York City.

CHAPTER 1

The Cameraman's Duties and Responsibilities

In the major film studios, the duties and responsibilities of each member of the camera crew are strictly defined.

The following contains the essentials of the "Division of Work and Duties" section of the agreement between Hollywood Film producers and the International Photographers of the Motion Picture Industries, Local 659 (Cameramen), of the International Alliance of Theatrical Stage Employes and Moving Picture Machine Operators of the United States and Canada. The material has been modified somewhat, and expanded to include job requirements based upon the author's experience in the field:

At all times, Cameramen . . . shall be responsible for doing their work to the utmost of their ability, artistry, and efficiency, and strive to uphold the best traditions of the photographic profession. Bearing in mind that upon their efforts rests the ultimate responsibility of reproducing in artistic and visible form the results of the great expenditures undertaken by the Producer, they shall also strive to perform their work as efficiently, rapidly, and excellently as is possible, seeking to heighten their efficiency and that of the Production unit with which they work.

The Director of Photography (First Cameraman) must be completely familiar with and able to: light studio and location settings; compose scenes; take meter readings; select lenses; determine the use of filters, gauzes, mattes, and diffusion discs; call attention to and solve any photographic problems pertaining to the production which may arise.

Whenever requested by the Producer, he shall help and advise the Producer, attend story conferences, give advice and suggestions in connection with the design and selection of sets, costumes, and locations as they relate to photography, and generally render assistance in simplifying production, in heightening production values, and affecting economies.

The Camera Operator (Second Cameraman) must be completely familiar with and able to: execute smooth and efficient camera movements; maintain the composition(s) prescribed by the Director of Photography; certify each "take" as it relates to the camera operation; set the groundglass focus; ascertain the parallax; regulate all shutter changes; note footage count; assure the security of the mounted camera.

The Assistant Cameraman must be completely familiar with and able to: check out camera equipment and accessories to determine they are in working order and that no items are missing; inventory

and record all raw stock assigned him; load magazines; assemble and prepare the camera at the photographic site; make hand tests; run the tape; set marks; check parallax; handle the slate; make camera reports; set lens aperture; regulate all focus changes; record meter readings; execute use of filters, gauzes, mattes, and diffusion discs; change lenses, check gate, change magazines; thread camera; disassemble and store camera equipment and accessories; charge camera batteries; unload and reload magazines; label, pack, and ship exposed stock to the laboratory; reinventory film supply; present duplicate camera, raw stock, and exposed stock reports to the Production Manager; any further necessary and incidental work that may be required.

Small production houses, in-plant industrial film units, and news and documentary film units may not always adhere closely to these definitions. Nevertheless, before a person can call himself a Cameraman, he must know and be able to perform the duties of each classification. This knowledge separates the professional from the amateur.

CHAPTER 2

Camera-Film Identification

The physical properties and chemical composition of film stock are well covered in other books. In addition, detailed data sheets covering such information as ASA indexes, D–log E curves, etc., are available from individual film manufacturers. There will be no attempt to duplicate that information here. Rather, points will be covered with which the Cameraman must be familiar but which are often overlooked.

Raw stock, i.e., unexposed film, is marked in various ways so that the Cameraman faced with unidentified raw stock can, by following a few simple procedures and consulting tables, correctly identify the product in question.

Knowledge of certain standards and specifications enables the Cameraman to base his decisions with regard to the selection of raw stock for a particular job upon the final intended use of the film.

Also, efficient methods for ordering, handling, and safeguarding raw stock can save the Cameraman valuable time and needless trouble.

This information is called camera-film identification and refers only to raw stock.

Camera-film identification consists of identifying (1) film type, (2) perforation and pitch, (3) winding, and (4) spool and core type.

2.1 FILM-TYPE IDENTIFICATION

Film cans and cartons are clearly labeled as to type, emulsion, and roll number (often erroneously called "slit" or "cut") of a specific batch. To aid in further identification each manufacturer incorporates characteristics on and/or in the raw stock emulsion. Such identifications generally include the following:

2.1a Punchmarks at head and/or tail, indicating:

Type number (often including emulsion number and roll number), film name, and code numbers or initials (see Tables 2-1–2-5).

2.1b Visible stenciled initials or numbers (see Tables 2-1–2-5).

2.1c Latent image printed initials or numbers (see Tables 2-1–2-5).

2.1d Latent image symbols for manufacturer's use

Manufacturers incorporate latent image-code symbols in each roll of film. These symbols provide information in regard to slitting, perforating, coating, date of manufacture, etc., and are intended only to enable the manufacturer to trace possible errors in various batches.

2.1e Frame-line markings

In general, 35mm negative frame-line markings (short dashes) distinguish safety-base film from nitrate-base film. Safety-base frame-line markings run parallel to the *length* of the film between perforations.

Nitrate-base frame-line markings run parallel to the *width* of the film between perforations. (In some cases nitrate-base frame-line markings may run parallel to the length of film, but are *between* the film edge and perforation mark.) Frame-line markings are visible before and after development.

NOTE: Although nitrate-base film has not been manufactured since 1950, some is still in existence. This film (both raw stock and print) is inflammable and considered dangerous. It is illegal to store nitrate-base film in anything other than an approved fireproof vault; it is illegal to mail it; and it is illegal to ship it unless conspicuously marked, "Inflammable Materials," and packaged according to Interstate Commerce Commission regulations. Warnings should be given to anybody asked to handle it; and old film, especially if it shows signs of decomposition, should be disposed of by the fire department.

TABLE 2-1

FILM-TYPE IDENTIFICATION

AGFA-GEVAERT: AGFA GEVAERT, INC., BELGIUM

Film type	2.1a Name	2.1a Type No.	2.1a Code	2.1b Edge Visible	2.1c Stencil Latent
B&W Negative	Gevapan 30	T1.65 (35mm) (16mm)	*		N
B&W Negative	Gevapan 36	T1.92 (35mm) (16mm)	*		H
Color Negative	Gevacolor	T6.55 (35mm) (16mm)	*		
B&W Reversal	Gevapan 30	T8.63 (16mm)	*		N
B&W Reversal	Gevapan 36	T8.80 (16mm)	*		H
Color Reversal	Gevachrome	T6.00 (16mm)			
Color Reversal	Gevachrome	T6.05 (16mm)			

The latent image name "AGFA-GEVAERT" appears every 16 frames on 35mm film; every 20 frames on 16mm film.

AGFA-GEVAERT 35mm daylight spools contain approximately 112′ (plus or minus 3″); 16mm daylight spools contain approximately 108′ (plus or minus 3″). The additional footage is allowed for threading and unloading and is sufficient to provide complete light protection.

35mm and 16mm darkroom loads contain approximately 10′ additional footage for threadup.

*Except for 100′ rolls, Agfa-Gevaert films are not punchmarked with code, type name, or type no. Instead the emulsion no. and roll no. of each batch are printed on the label of the can or carton. 100′ rolls have the type no. and emulsion no. punchmarked to indicate the beginning of the roll. At the end of the roll the word "EXP" and the type no. are punchmarked.

TABLE 2-2

FILM-TYPE IDENTIFICATION

DUPONT: E. I. DUPONT DE NEMOURS & CO. (INC.)

Film	2.1a Name	2.1a Type No.	2.1a Code	2.1b Edge Visible	2.1c Stencil Latent
B&W Negative	Superior 2	936A (16mm)	*	2†	V
		936B (35mm)	*	2†	V
B&W Negative	Superior 3	937A (16mm)	*	3†	XY
		937B (35mm)	*	3†	XY
B&W Negative	Superior 4	928A (16mm)	*	4†	X
		928B (35mm)	*	4†	X
B&W Reversal‡	Rapid Reversal	930A (16mm)	*	3†	Y
B&W Reversal‡	High-Speed Rapid Reversal	931A (16mm)	*	+†	Z
		931B (35mm)	*	+†	Z
B&W Reversal‡	Ultra Speed Rapid Reversal	932A (16mm)	*		UY
		932B (35mm)	*		UY

The latent-image name "DUPONT" appears every 16 frames on 35mm film; every 40 frames on 16mm film.

DuPont 35mm daylight spools contain 112′ (plus or minus 3″); 16mm daylight spools contain 108′ (plus or minus 3″). The additional footage allows for threading and unloading and is sufficient to provide complete light protection.

DuPont 35mm and 16mm darkroom loads contain approximately 10′ additional footage for threadup.

*DuPont 35mm and 16mm stock (spool and darkroom load) is punchmarked with full type no. only at the head of the roll; no emulsion no. or roll no. follows; no tail I.D.

†Precedes latent footage number.

‡While designed for development as Reversal, it may also be used as a negative.

TABLE 2-3

FILM-TYPE IDENTIFICATION

EASTMAN: EASTMAN KODAK COMPANY

Film	2.1a Name	2.1a Type No.	2.1a Code	2.1b Edge Visible	2.1c Stencil Latent
B&W Negative	XT Pan	5220 (35mm) 7220 (16mm)	XT XT		F
B&W Negative	Plus-X Pan (Type B)	4231 (35mm) 7231 (16mm)	PXN PXN		H
B&W Negative	Double-X Pan	5222 (35mm) 7222 (16mm)	DXN DXN		C
B&W Negative	Tri-X Pan	5233 (35mm) 7233 (16mm)	TXN TXN		A
B&W Negative	4-X Pan	5224 (35mm) 7224 (16mm)	4XN 4XN		G
B&W Negative	RP Pan	7229 (16mm)	RP		
Color Negative	Color Neg	5254 (35mm) 7254 (16mm)	ECN ECN		E
Color Reversal	Ektachrome Commercial	7255 (16mm)	EKTA C		
Color Reversal	Ektachrome MS	5256 (35mm) 7256 (16mm)	EMS EMS		
Color Reversal	Ektachrome EF (Daylight)	5241 (35mm) 7241 (16mm)	EF EF		
Color Reversal	Ektachrome EF (Type B)	5242 (35mm) 7242 (16mm)	EFB EFB		
B&W Reversal	Plus-X	7276 (16mm)	PXR		
B&W Reversal	4-X Rev	7277 (16mm)	4XR		
B&W Reversal	Tri-X	7278 (16mm)	TXR		

The latent image name "EASTMAN KODAK" appears every 16 frames on 35mm film; every 40 frames on 16mm film.

Eastman 35mm daylight spools contain 109′ (plus or minus 4″); 16mm daylight spools contain 109′ (plus or minus 4″). The additional footage allows for threading and unloading, and is sufficient to allow complete light protection. Eastman 35mm and 16mm darkroom loads contain approximately 10′ additional film for threadup.

35mm and 16mm darkroom loads are punchmarked at both ends of the roll with type no., emulsion no., and roll no.

NOTE: It is the manufacturer's intention that both ends of every roll of film have the same identification. However, due to the need to remove samples for extra testing in the factory, the core-end (tail) identification is sometimes lost.

TABLE 2-4

FILM-TYPE IDENTIFICATION

GAF: GAF CORPORATION

Film	2.1a Name	2.1a Type No.	2.1a Code	2.1b Edge Visible	2.1c Stencil Latent
B&W Negative	Versapan	5531 (35mm)* 2531 (16mm)†	31‡		
B&W Negative	Super Hypan	5671 (35mm) 2671 (16mm)	67		
B&W Reversal	Medium-Speed Reversal	2955 (16mm)§	55‖		
B&W Reversal	High-Speed Reversal	2961 (16mm)	61		
B&W Reversal	Gafpan High-Speed Reversal	2962 (16mm)	62		
Color Reversal	Anscochrome D64	5311 (35mm) 2311 (16mm)¶	11		
Color Reversal	Anscochrome T/100	5240 (35mm) 2240 (16mm)	40		
Color Reversal	Anscochrome D/200	5230 (35mm) 2230 (16mm)	30		
Color Reversal	Anscochrome D/500	5550 (35mm) 2550 (16mm)	50		

The latent image name GAF appears every 16 frames on 35mm film; every 40 frames on 16mm film.

GAF 35mm daylight spools contain approximately 112′ (plus or minus 3″); 16mm daylight spools contain approximately 108′ (plus or minus 3″). The additional footage allows for threading and unloading, and is sufficient to provide complete light protection.

GAF 35mm and 16mm darkroom loads contain approximately 10′ additional footage for threadup.

*All GAF 35mm stock (spool and darkroom load) is head punchmarked with the type no., emulsion no., and roll no. at the head of the roll only.

†All GAF 16mm B&W negative stock is head punchmarked with the film name.

‡All GAF B&W negative stock and color reversal stock (spool and darkroom load) is tail punchmarked with the word "EXPOSED" followed by the emulsion no., followed by two code digits (e.g., EXPOSED 372-67).

§All GAF 16mm B&W reversal stock (spool and darkroom load) is head punchmarked with the type no. only, with the last digit separated by a hyphen (e.g., Medium Speed Reversal is punchmarked: 295-5).

‖All GAF 16mm B&W reversal is tail punchmarked with the word "EXPOSED" only (no emulsion no, or code no.)

¶All GAF 16mm color reversal (spool and darkroom load) is head punchmarked with the word "Color," followed by either a "D" (for daylight) or a "T" (for tungsten).

TABLE 2-5

FILM-TYPE IDENTIFICATION

ILFORD: ILFORD LIMITED, ENGLAND

Film	2.1a Name	2.1a Type No.	2.1a Code	2.1b Edge Visible	2.1c Stencil Latent
B&W Negative	H.P. 3	(16mm)* (35mm)*	†	A, B, or C	‡
B&W Negative	H.P. S	(16mm)* (35mm)*	†	F or G	‡
B&W Negative	Pan F	(16mm)* (35mm)*	†	J or K	‡
B&W Negative	F.P. 3	(16mm)* (35mm)*	†	L or M	‡
B&W Negative	Mark 5	(16mm)*	†	S or T	‡

*A type no., which is also coded, is allocated to all Ilford films. Only the type no. need be quoted when ordering, and a complete list of types and codings is given in the "Ilford Motion Picture Films Type List," available from the manufacturer on request.

An example of the coding is given below:

35/FP3/101/CP1/EO

- Film size
- Film type or base type
- Length in feet
- Core or spool
- Winding

The above example is shown in the Motion Picture Type List to be No. 502.

35mm and 16mm daylight spools contain approximately 115′ of film. The additional footage allows for threading and unloading and is sufficient to provide complete light protection.

†Ilford films are not punchmarked with name, type no. code, or roll no. These details are found on the can labels.

‡A two-letter prefix precedes all latent footage numbers. The first of these indicates the material: e.g., in LE 2A12345, the letter "L" indicates F.P.3 stock.

2.2 PERFORATIONS AND PITCH

Perforations and pitch used in the United States conform to the "Cutting and Perforations Dimensions for Raw Stock" as set forth by the USA Standards Institute (formerly the American Standards Association). These standards and all other standards and recommended practices pertaining to motion-picture films and to their use in cameras and projectors were developed by the Society of Motion Picture & Television Engineers (SMPTE), who have the sole responsibility for their accuracy. Committees of the SMPTE periodically review these standards to assure they are kept up to date. They are released through the United States of America Standards Institute, 10 East

40th Street, New York, N. Y. 10017. A complete list of all motion-picture standards is available from the USASI upon request.

All 35mm camera film and 16mm *silent* camera film is double perforated with two precisely located rows of holes, one along each edge of the film.

16mm *sound* camera film is perforated with one row of holes only, to allow for direct sound track or magnetic striping.

Variations for both 35mm and 16mm are in (a) perforation shape, and (b) length of pitch—expressed as "long" or "short" pitch.

2.2a Perforation shapes (Fig. 2-1)

It should be noted that "negative perforation" and "positive perforation" designate the size and shape of the *perforation* and not the type of film (negative or reversal). As a rule, film with negative perforation is intended for subsequent projection (making prints from it). Film with positive perforation is designed for use as print stock. However, high-speed camera film has a positive perforation. The rounded KS (Kodak Standard) corners are stronger than the sharp BH (Bell & Howell) corners and the film is able to better withstand the strain of the initial roll through a high-speed camera.

Fig. 2-1. Raw stock perforation shapes (35mm). The BH (Bell & Howell) perforation (left) has curved sides, straight top and bottom, and sharp corners. This is called a "negative perforation." USASI PH 22.93, where: C = 0.1100; D = 0.0730; H = 0.082. The KS (Kodak Standard) perforation (right) has straight sides, a straight top and bottom, and a slight radius on the corners. This is called a "positive" or "high-speed perforation." USASI PH 22.139, where: C = 0.1100; D = 0.0780; R = 0.020. The letters C, D, H, and R conform to the dimension letters used by the USASI and are expressed in decimal inches and/or millimeters. NOTE: The letters BH and KS refer to those who developed the particular perforation.

2.2b Pitch (Figs. 2-2, 2-3)

In both 35mm and 16mm film, pitch is the distance from the leading edge of one perforation to the leading edge of the next perforation. Pitch is commonly referred to as "long" or "short" depending on the dimension.

Most camera films are perforated "short" pitch because they will be printed on a continuous contact printer on a circular printing drum. The negative is next to the drum and the print stock is on the outside. Geometrically, the negative stock must have shorter pitch than the print stock to produce rock-steady sharp prints.

2.2c Perforation and pitch selection

The Cameraman's selection of raw stock with certain perforation shape and pitch dimension is predicated on the intended use of the film, as outlined in Table 2-6.

2.3 WINDINGS

2.3a E.I. and E.O.

The standard winding of film manufactured in the United States is emulsion in (E.I.). On special order any American manufacturer will supply film wound emulsion out (E.O.). While many foreign cameras require film wound E.O., the cameras designated in this manual utilize film wound E.I. Exceptions are the 35mm Eclair Cameflex and the 16mm Eclair NPR, which are designed to take either wind.

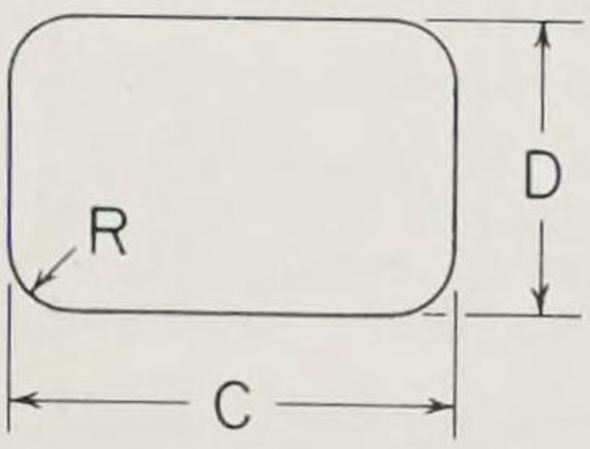


Fig. 2-2. Raw stock perforation shape (16mm). All 16mm perforations are rectangular with straight top and bottom, straight sides, and a slight radius on the corners. USASI PH 22.12, where: C = 0.0720; D = 0.0500; R = 0.010. The letters C, D, and R conform to the dimension letters used by the USASI and are expressed in decimal inches and/or millimeters.

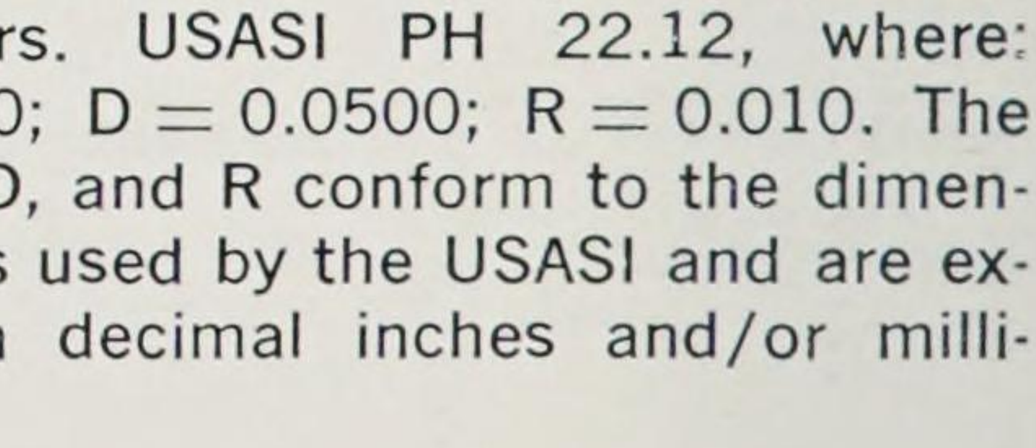


Fig. 2-3. Pitch measurement: in 35mm, B = 0.1866 (short pitch), 0.1870 (long pitch); in 16mm, B = 0.2994 (short pitch), 0.3000 (long pitch). The letter B conforms to the dimension used by the SMPTE to denote pitch and is expressed in decimal inches and/or millimeters.

TABLE 2-6

PERFORATION AND PITCH SELECTION

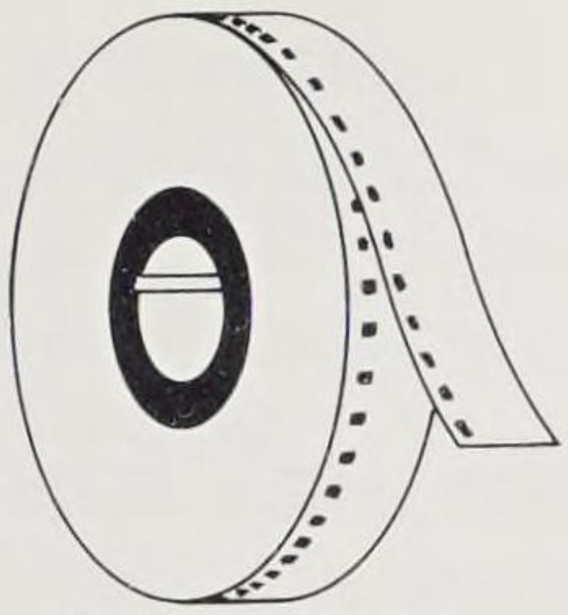
35mm

Intended Use	Common Designation	USASI (ASA) Spec. No.	Pitch Designation
For making release prints	Negative perforation, short pitch	PH 22.93	BH—1866
Direct projection or high-speed up to 1000 frames per second	Negative perforation, long pitch	PH 22.34	BH—1870
Ultra high-speed (1000 frames per second or more)	High-speed perforation	PH 22.36	KS—1870

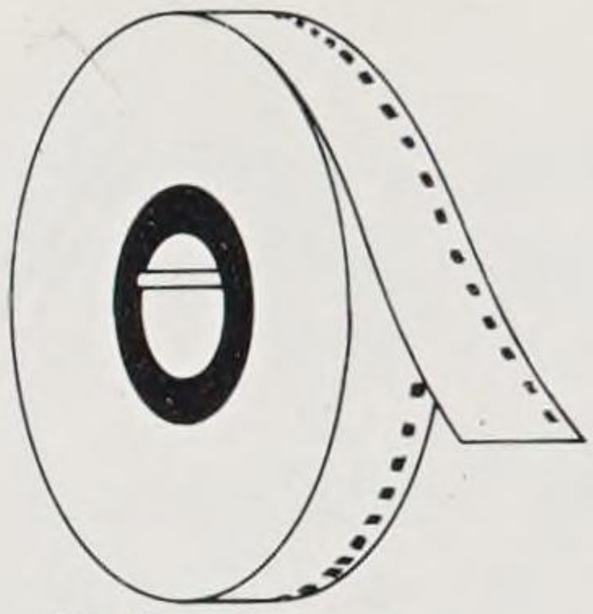
16mm

For making release prints	Camera original, double perforation, short pitch	PH 22.110	2R—2994
Direct projection and/or single system cameras	Camera original, sound (or single) perforation, long pitch	PH 22.12	1R—3000
Direct projection and/or high-speed	High-speed perforation, long pitch	PH 22.5	2R—3000

*BH indicates negative type perforations; KS indicates positive type perforations; the number following designates the pitch dimension. 1R indicates one row of perforations; 2R indicates two rows of perforations; the number following designates the pitch dimension.



"A" WINDING
EMULSION SIDE IN



"B" WINDING
EMULSION SIDE IN

Fig. 2-4. Windings: USASI PH 22.75.

2.3b A-wind; B-wind (Fig. 2-4)

16mm single-perforated (sound) film is supplied in *A-wind* or *B-wind*. "A" and "B" refer to position of the perforations on an E.I. roll. A-wind is intended for making contact prints in the laboratory and is *not* for camera use. B-wind is intended for use as a camera stock, and also for the making of optical prints in the laboratory. With emulsion facing the camera aperture, only B-wind film will fit single-pulldown-claw cameras.

If in doubt as to whether film is A- or B-wind, a simple darkroom procedure will identify the winding immediately: with emulsion side in, hold the roll in the left hand; then pull the film end with the right hand making certain the film leaves the roll clockwise at the top. B-wind perforations will be farthest from the body; A-wind perforations will be closest to the body.

Some Cameramen use the expression, "A left clock is far better," to remind themselves that holding the roll in the left hand, with the film leaving the roll clockwise, the far perforation is Better.

2.4 SPOOL AND CORE TYPES

Each manufacturer designates his metal spools and/or plastic cores as indicated in Table 2-7.

2.5 ORDERING RAW STOCK

Each manufacturer uses a system of order-filling to ensure the most expedient service. Confusion and delay in response to orders can invariably be traced to information omitted or improperly submitted.

Manufacturers recommend that orders contain the following information: (1) number of rolls; (2) width of film; (3) length of roll; (4) name of film; (5) type number; (6) perforation and pitch; (7) in regard to single-perforated film, designation B-wind for camera use; (8) core or spool type. (See Table 2-8.)

2.6 SHIPPING INSTRUCTIONS

Shipping instructions to the manufacturer should contain complete information, including (1) *when* the order is to be sent (SHIP); (2) *conveyance* preferred (VIA); (3) *address* of consumer ordering (TO); (4) and any *other* pertinent data that would facilitate delivery (SPECIAL INSTRUCTIONS). (See Table 2-9.)

TABLE 2-7

SPOOL AND CORE TYPES

Manufacturer	Spool (footage)				Core (diameter)				
	50′	100′	200′	400′	1″	2″ neg*	2″ univ†	3″	4″
35mm									
Agfa-Gevaert	CNU-30	CNU-30			CNP-1	CNP-4	CNP-2	CNP-3	
Ansco					"B"	"A"			
Dupont		16			4		24		
Eastman	S-100	10	S-101		"AA"	"R"	"U"	"K"	
Ilford	S-30				CP-1	CP2N	CP2P		
16mm									
Agfa-Gevaert	CSU-30						CSP-3		CSP-32
Ansco									
Dupont		44	49	60			32		
Eastman		R-90	R-190	R-153			"T"	"Z"	
Ilford		S-10	S-12				CP-2	CP-3	

*Although the manufacture of the 2″ negative (male) 35mm core has been discontinued, many are still in circulation and may be encountered. It is distinguished by an approximately 3/16″ key, extending halfway through the center.

†The standardized 2″ universal (female) core is distinguished by a keyway extending all the way through the center.

NOTE: No entry indicates the spool or core is designated by its footage size or core diameter.

TABLE 2-8

EXAMPLES OF ORDERS

Company	(1) Units	(2) Width	(3) Length Per Unit	(4) Name	(5) Type No.	(6) Perf. and Pitch	(7) Wind*	(8) Spool or Core
Agfa-Gevaert	10 rolls	35mm	400′	Gevapan 30	1.65	N		CNU-30
	5	16mm	1200′	Gevapan 36	8.80	S.1.2		CNP-3
Ansco	6	35mm	400′	Color	5230	(BH 1866)	B-Wind*	"A"
	10	16mm	400′	Sup Hypan	2960	(IR 3000)		2"†
Dupont	3	35mm	1000′	Sup 2	936B	(KS 1870)		44
	12	16mm	400′	Rapid Rev	930A	(2R 2994)		32
Eastman	8	35mm	400′	Dble-X Neg	5222	(BH 1866)	B-Wind*	U
	7	16mm	1200′	Plus-X Rev	7276	(IR 3000)		Z
Ilford	10	35mm‡	400′‡	FP 3‡	‡	§		CP2N‡
	4	16mm‡	100′‡	Mk V‡	‡	§		S10‡

*Indicate B-Wind for camera use when ordering single-perforated film.
†When no spool or core type is designated by the manufacturer the spool footage or core diameter is noted.
‡As noted in Table 2-5, by utilizing the manufacturer's "Motion Picture Films Type List" only the units and a type number is necessary.
§Ilford perforation and pitch dimensions are according to British Standard Specifications (BSS) which are equivalent to the ASA (now USASI) specifications. Only some of their terminology differs. E.g., BH 1870 is called standard pitch; KS 1870 is called positive raw stock; BH 1866 is called short pitch.

NOTE: When ordering from other than U.S. manufacturers the winding (E.I. or E.O.) must be stated. In the U.S., unless E.O. is specified (as a special order) the manufacturer will supply film wound emulsion in (E.I.).

TABLE 2-9

SHIPPING INSTRUCTIONS

Ship	Via	To
ASAP ("as soon as possible")	AIREX (Air Express)	NAME—of consumer
TO ARRIVE—date film will be required (at least two days before start of production)	AIRFRT (Air Freight)	ADDRESS—of consumer
	YOUR CARRIER—Manufacturer's shipping agent (usually by truck)	CITY, STATE—of consumer
	SPECIFIC DELIVERY COMPANY—consumer's shipping agent	ATT:—name of person who is to receive film

SPECIAL INSTRUCTIONS (examples)

If consumer desires to pick up shipment, mark shipping label: HOLD AT AIRPORT; CALL UPON ARRIVAL (include phone number).

When shipment leaves the manufacturer's establishment: TELEGRAPH (OR PHONE) (CARRIER), (WAYBILL NUMBER), (FLIGHT OR CARLOAD NUMBER).

Communicate by phone or telegraph: NOTIFY US OF ANY SHORTAGES OR DELAYS IN SHIPMENT.

It should be noted that while the supplier invariably places a warning label on the shipping carton which reads, "PHOTOGRAPHIC FILM–KEEP AWAY FROM RADIOACTIVE MATERIALS," it is important to notify the supplier to label the carton as such. Because of the constant flow of radioactive isotopes for medical use on common carriers, there is a constant threat of contamination to all film shipments–raw stock and exposed. If shipment is suspect or arrives without a warning label, *set it aside* and send one roll to the manufacturer with the notation, "RAW STOCK–CHECK FOR EXPOSURE TO RADIATION–NOTIFY RESULTS IMMEDIATELY BY PHONE," and be sure to attach a proper warning label to the wrapper of that roll. It is better to wait for a new, properly labeled shipment than risk a streaked or fogged negative and have to reshoot.

CHAPTER 3

Loading-Room Procedures

Loading-room procedures must be studied thoroughly; when they become "second nature," they will insure maximum efficiency. A loader should never deviate from the routine: consistency in placement of film, tools, and supplies enables the loader to conduct himself in darkness with the ease and familiarity of working in daylight.

3.1 TESTING THE LOADING ROOM

The most important step in loading is the first: guaranteeing an absolutely lighttight room. A loading room must be considered unsafe until tested, regardless of whether it is a permanent, temperature-controlled, air-filtered installation or a portable plywood "hotbox" on a sound stage. Ambient light filtering through wall punctures, air vents, or doorjamb cracks is not noticed until at least 5 minutes after the darkroom is entered. A rule of thumb for testing lighttight security is to hold the hand 12 in. from the face after being in the darkroom 5 minutes; if the hand is seen, light leakage can be plugged up with black masking tape. In any case, every loading room must be made lighttight.

3.2 THE HOTBOX

The sound-stage portable loading room "hotbox" usually takes up no more than 4 x 4 ft in floor space, a sufficient area for the work to be done. It is generally constructed and utilized as follows (see Fig. 3-1): The door, with interior lock, is at the loader's back. Opposite the door is a workbench approximately 18 x 48 in. for loading the magazines. The bench surface is prepared by placing–*to the left*–the same number of cans of raw stock as the number of magazines to be loaded. The magazine to be loaded (or unloaded) is placed in the *center*. Canned, exposed film is placed to the *right*.

On the floor below the bench the raw stock inventory is placed to the *left*. A small box or wastebasket is placed in the *center* and, next to the basket, space is reserved for short-end cans. A carton containing empty, unload cans and black bags is placed to the *right*.

Empty magazines, or exposed magazines to be unloaded, are placed on the floor behind and to the loader's left (as he faces the bench); loaded magazines are placed on the floor behind and to the loader's right.

Directly over the bench hanging on nails are, from left to right: one roll of camera tape; one pair of scissors; one magazine brush; one air syringe (more elaborate loading rooms are equipped with air hoses to clean magazines); one marking pen; and one film inventory list.

On a shelf above the loading bench are: a box of spare take-up cores;

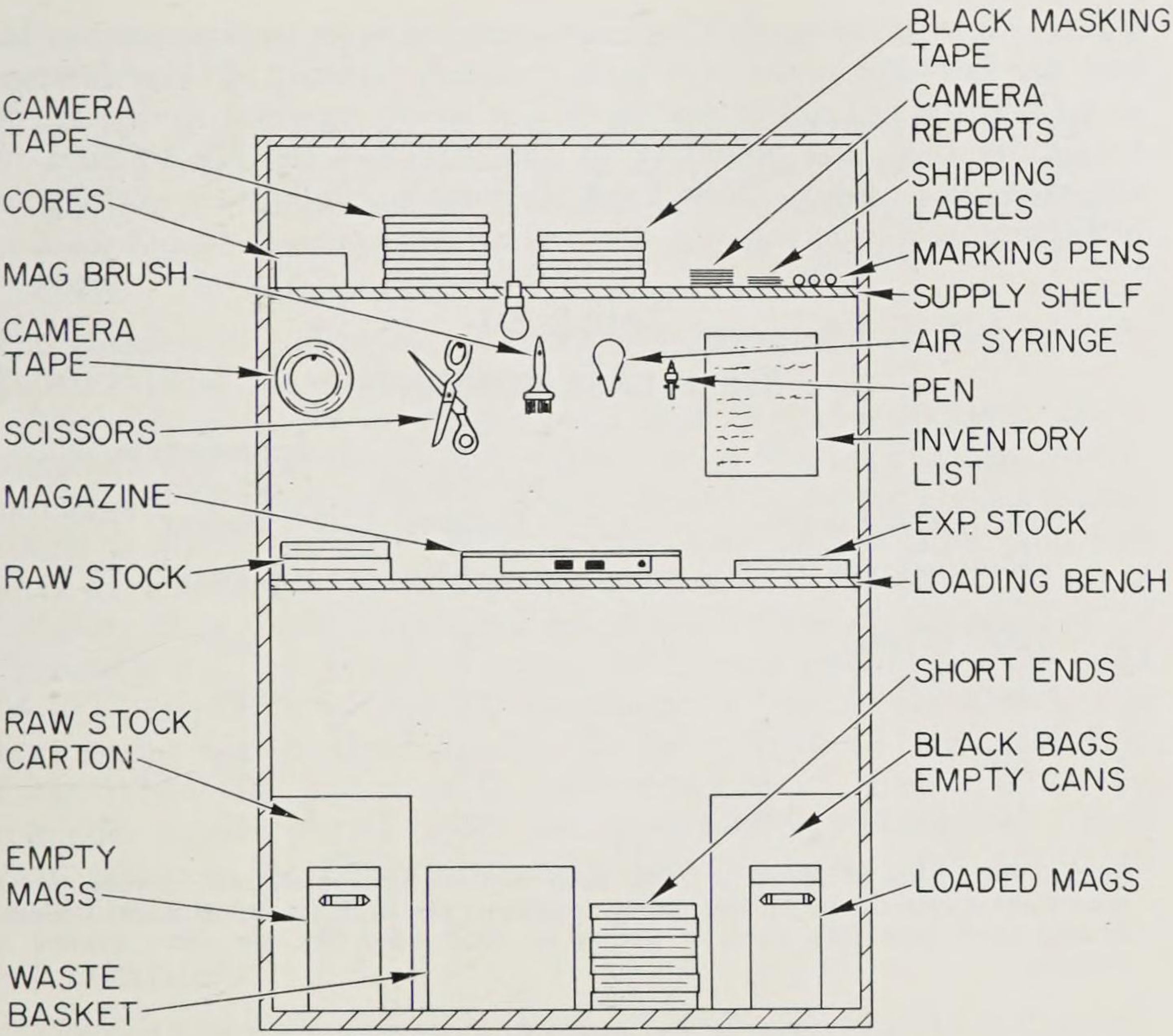


Fig. 3-1. Hot box elevation.

spare rolls of camera tape; spare rolls of black masking tape; extra camera reports; shipping labels; and additional marking pens.

An overhead light with a short pull-chain should be above and behind the loader. (Long pull-chains and wall switches are subject to accidental snagging in moments of haste—and there are many such moments!) The overhead light should be low enough so that the loader's shadow always covers the magazine being loaded. Should the light be turned on accidentally or the door opened when a magazine lid is off, the loader's shadow may protect the roll from exposure at least enough to confine fogging to the perforations only, thereby saving the frame area. Direct light would fog deep into the picture area and render the entire roll useless in the split second before the light could be extinguished. In either case, a "slop test" (see Sec. 3.10) would be mandatory.

A word of caution regarding loading-room lightbulbs: If a bulb does not illuminate in the room when the chain is pulled, or when seating the bulb in the socket, or when checking the plug-in connector, for safety's sake *completely remove the bulb from the socket!* Many a

loader, after deciding that *nothing* electrical is in working order, has had the sad experience of a bulb suddenly lighting up the darkness as he holds a full roll of raw stock (or worse, exposed stock!) in his hands. By then, the pounding on the wall and the Electrician's reassuring voice calling, "Hey, I got the juice to the line for you!" gives little comfort.

TABLE 3-1

35mm CASE CONTENTS

Roll Length	Number of Cartons	Approximate Shipping Weight
1000′ (B&W)	10*	56 lb
1000′ (Color)	8	46
400′	20	52
200′	20	29
100′ (on No. 10 Spool)	50	43

*In case lots, cans of 35mm × 1000′ b&w film are packed without cartons, which allows for an inventory of two more cans per case than for color stock. Ordered in less than case lots, cans of 35mm × 1000′ b&w film are often packed in cartons.

TABLE 3-2

16mm CASE CONTENTS

Roll length	Number of Cartons	Approximate Shipping Weight
1200′	20 singles	60 lb
	10 doubles*	60
400′	30	44
200′ spool	30	30
100′ spool	50	24

*Two 16mm × 1200′ rolls (b&w or Color) are packed in one 35mm × 1200′ film can. Each roll is individually wrapped in a black labpack bag.

3.3 PREPARATION OF MATERIALS

Dirt is the prime enemy of all loaders: a loading room must be cleaned thoroughly prior to bringing in supplies, equipment, and/or magazines, and should be cleaned again when the job is completed.

Upon receipt of raw stock, an inventory is taken and the number of cases and/or cartons is noted. This inventory is kept separately from

the camera-report inventory (see Chapter 5, "Camera Reports"), and is posted above the bench.

> NOTE: A case contains many cartons. A carton contains one can. A can contains a roll of film wound on a core, and wrapped in a black bag if it is a darkroom load, or wound on a spool if it is a daylight load. Some 16mm cans contain two rolls wrapped in individual black bags.

The contents of full cases of 35mm and 16mm film are indicated in Tables 3-1 and 3-2, respectively.

The footage count on each carton label must be checked. Occasionally a roll from the manufacturer will be less than standard footage length, in which case the footage amount must be circled prominently in ink on the carton label as well as on the can label. This will serve to call attention to the irregular amount.

Later, when loading the short roll, a small piece of camera tape (a "reminder tape") is prepared stating the footage amount and the word "only" (e.g., "975 ft ONLY") as though it were a short end. The tape is put next to the magazine ID (identification) tape (see Sec. 3.5). When the magazine is later mounted on the camera, this reminder tape is placed below the camera footage counter as a constant notice to the Operator that he does not have a full roll. Once the roll has been expended, of course, the reminder is removed.

3.4 LOADING

Cans of raw stock (equal to the number of magazines to be loaded) are placed to the left on the work bench. The magazine is placed in the center and cleaned thoroughly. (See Section on Magazines, Chapter 7.) The can of raw stock is unsealed by peeling a short section of tape from the circumference of the can, and affixing the tape end to the wall of the loading room. While holding the can firmly, to keep the lid from opening, rotate the can downward so that the tape unrolls and sticks to the wall.

A visual check of the bench is essential, before turning off the light, in order to determine the location of the magazine lid and other necessary items. *When the room is dark* the can is opened and the roll of raw stock is taken out of the black bag.

> WARNING: Some manufacturers use a *sealing tape* on a roll of film, to prevent unraveling of the stock. This innocent-looking tape, approximately 1 x ¼ in., if not properly disposed of, can become a cause of grief, expense, damage to the camera, and loss of a crew's time. When this tape is removed from a roll it must be stuck immediately *to the inside of an empty can* so that it will not accidentally fall into an open magazine and eventually do great damage.

The raw stock is loaded into the magazine, the feed lid replaced, and the black bag stored in the empty can.

> NOTE: It is often difficult to insert the film end into the light trap roller. The film is thin, and when it meets resistance from the rollers

it buckles. To overcome this problem with nongear magazines, a diagonal (lengthwise) "fold" is made of the first 8 *in. of the film end;* the doubled thickness will feed in more easily. When loading gear-thread magazines, cut across a frame through the middle of both perforations. This permits the film end to mesh with the gear tooth, and threading can continue.

The take-up side of double-compartment and coaxial magazines (see "Magazine," Chapter 7) may be worked on in the light. The feed and take-up sides of displacement-type magazines must be loaded in the dark.

The take-up core is placed on the core holder with the slanted slot in the core angled away from the direction in which the film takes up. Approximately 3 in. of the film end is folded back upon itself, and the fold inserted into the core slot. A few turns of the spindle wheel in the direction of take-up wraps enough film around the film end to prevent its slipping out of the core slot. By wetting a few inches of emulsion near the core with spit and giving it one more full turn the film will adhere to itself and be prevented from unraveling in the magazine.

Magazines with permanent cores merely require insertion of the film end into the core slot and locking in place.

3.5 MAGAZINE ID

After loading a magazine, a piece of camera tape is placed on the lid. (On double-compartment and coaxial magazines the tape is placed on the take-up lid, *not* the feed lid; the tape goes over the magazine lock on displacement magazines.) The tape is always extended across the opening of the lid so that the lid can not be removed thoughtlessly; it also serves as a warning that exposed film is on the inside of the take-up lid. Each piece of camera (ID) tape is inscribed with the following information:

1. Total amount of footage in the raw stock roll; e.g., "400 ft." 2. Type, emulsion batch, roll (cut), and can number, e.g., "5254-786-18-35."

NOTE: The total amount of footage and type of film are important to the laboratory; the emulsion batch, roll (cut), and can number are important to a manufacturer in tracing defects in film stock.

3. Magazine serial number; e.g., "Mag. No. 683."

NOTE: The magazine number is essential should the negative have a scratch—the Cameraman can then determine where the malfunction is: in the camera, or in a particular magazine.

4. Roll number (numerical order of magazine when placed on the camera); e.g., Roll No. 1.

NOTE: The roll number is very important to the Editing Department.

5. Date the magazine was loaded; e.g., "7/8/69." 6. The loader's initials; e.g., "G.S."

The information should thus appear on the ID tape as follows:

400 ft 5254-786-18-35
Mag. No. 683 Roll No. 1
7/8/69 G.S.

WARNING: *Edge Numbers*—Some production companies require that the first edge number on the roll of loaded film be recorded on the magazine report (see "Edge" in Sec. 5.2). On 35mm black-and-white film this number is determined by extending the film loop approximately 18 in. from the magazine feed side (after the lid has been closed) and, starting at the take-up throat, running a flashlight under the raw stock edge until the inked edge-footage number becomes visible.

In addition to the magazine ID, which is affixed to the *take-up lid*, many loaders also stick a small piece of camera tape on the *feed* side of a magazine lid as another safety measure, on the premise that having to remove tapes gives someone (regardless of the hurry he might be in) second thoughts about opening lids in daylight and possibly exposing film. To be absolutely sure, open *all* magazines in the dark.

REMEMBER: *Anyone finding an unmarked magazine has the right to assume it to be empty.*

3.6 UNLOADING

3.6a Complete rolls

When unloading a magazine, change the total amount of footage on the ID tape, substituting for the original number the amount of footage to be sent to the laboratory and adding the symbol, "EXP" (e.g., "380 ft EXP").

The ID tape is lifted and placed in the center of the take-up lid. The unload can, lid removed, is placed to the right of the magazine. The black labpack bag is readied. (Placing the hand in the bag and spreading the fingers makes it easy to receive the exposed stock.)

NOTE: In an emergency, a double-folded page from a newspaper or heavy wrapping paper can be substituted for the black bag.

Before the light is extinguished a visual check is made of the placement of all items. With the light out, the take-up side of the lid is removed and the exposed film is put inside the black labpack bag.

CAUTION: Some magazines have reusable cores. Do *not* ship the core to the laboratory with the exposed stock.

Exposed film is *never* sealed to itself as the raw stock was in the original packing; instead, the roll is rotated until the tail of the film is at the bottom of the black bag. The bag is then folded to conform to the roll size, the opening tucked under, and the package placed in the can. Replace can lid, then squeeze it tightly between arm and ribs while taping it.

NOTE: Exposed-film cans are sealed with plain camera tape. If the original tape used to seal the raw stock *can* is needed to seal a can of exposed film, the tape should be inverted so that the identifying numbers (type No., roll No., etc.) on the tape are upside-down when the can is stacked with the *label up*. Plain tape or inverted numbers quickly identify exposed film or short ends.

The ID tape is removed from the magazine lid and used to affix the camera report (see section on Camera reports: Disposition of reports, Chapter 5) to the lid of the can containing the exposed film. The *label* of the *can* is marked "Roll No._____ EXP." This is necessary in the event the camera report is removed or lost.

3.6b Partially exposed rolls

When a magazine containing a partially exposed roll is to be emptied completely, *two* unload cans (one to the left for the raw stock, one to the right for the exposed film) are placed on the bench. The exposed film, regardless of length, is canned first, and the can is labeled with the ID tape from the magazine.

The can of raw stock is marked with a piece of tape across the label, with the words, "SHORT END," the emulsion No., footage amount, date canned, and loader's initials as follows:

SHORT END
5254-786-18-35
170 ft only
7/8/69
G.S.

NOTE: Some production companies require that all 35mm short ends of less than 100 ft and 16mm short ends of less than 40 ft be wrapped, taped, and deposited in the silver-reclamation bin.

3.6c Unused rolls

Before canning raw stock that has been loaded but not used, rather than breaking the film off and destroying the head ID, three or four frames of the piece of film protruding from the light traps are marked in ink with a large "XXX" to indicate the film ahead of it has been exposed while loading. The roll is *not* retaped to conform to the manufacturer's packing. When loaded and retaped the can is marked as follows:

(Type of camera) loaded but not used
Emulsion No.
Run in and marked approx._____ft from head of roll
Date canned
Loader's initials

This marking permits the next loader to run down to the mark with the assurance that the film following the mark has not been exposed.

All film ends should be cut square across the film width (bisecting a perforation) before being canned. One attempt to thread the jagged

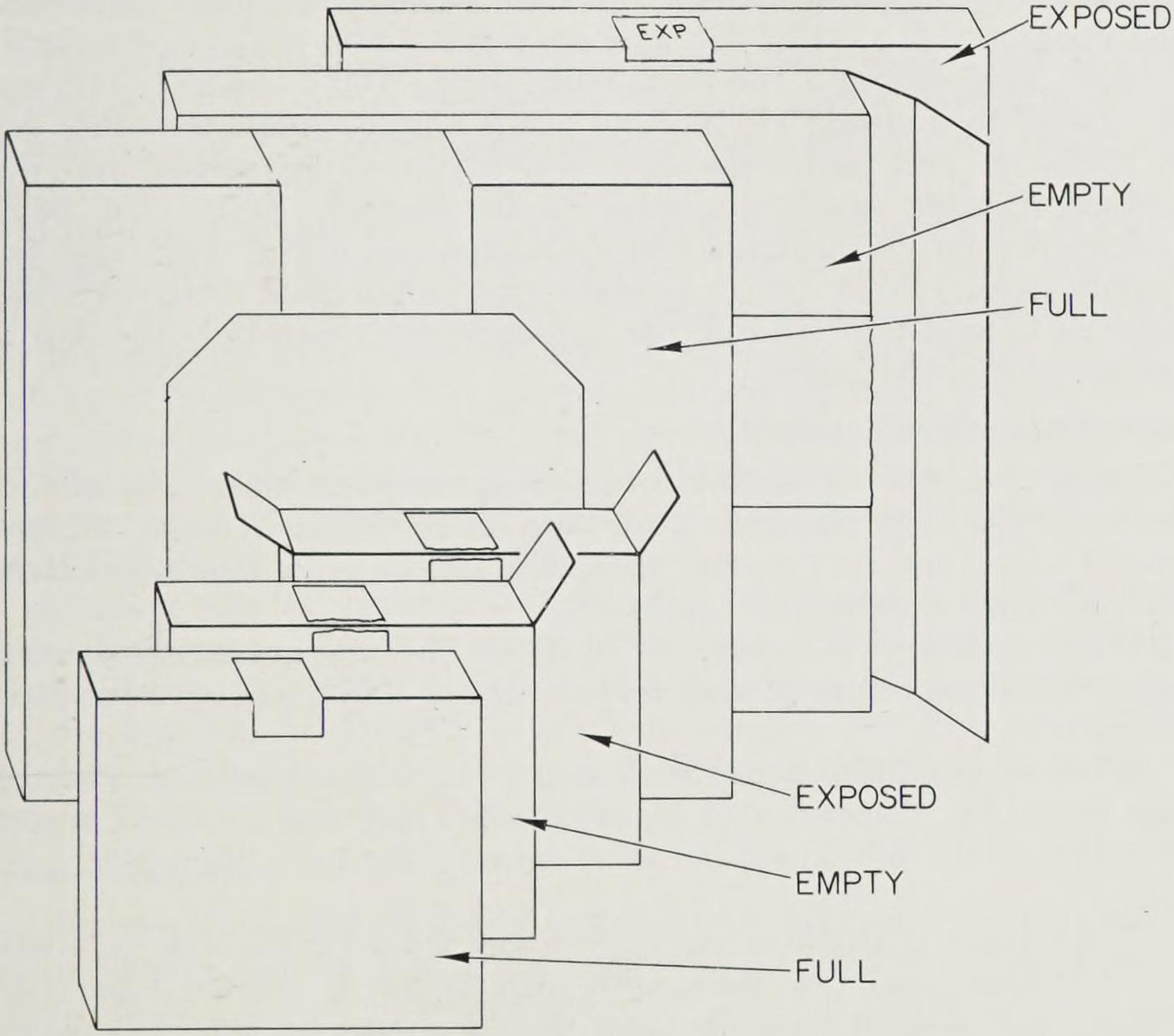


Fig. 3-2. Film boxes and cartons.

end of a torn roll into a gear-driven magazine will make a loader appreciate the squared film end.

3.7 EXPOSED FILM

Ship exposed film to the laboratory as soon as possible to avoid deterioration of the latent image. Until it is ready for shipment, exposed film is kept in a cool, dry place—separate from raw stock inventory so it will not be mistakenly loaded as raw stock (this *has* happened!!)

3.8 ON LOCATION

When working out of a truck or station wagon, space may be limited. In that circumstance the same case must be utilized for both raw and exposed stock. The following system should be used (see Fig. 3-2):

3.8a Cans in cartons

All raw stock is to be placed in the case so that only one of the sealed flaps on each carton is up, unbroken, and visible to the loader. After loading magazines, empty cans (e.g., 400–1200 ft) are replaced

in their original cartons; the cartons are to be set on their sides with the flap out of the carton (to indicate can is empty). On cartons with fold-in "ears" beneath the carton flap (e.g., 100-ft spools), one ear is allowed to protrude (to indicate can is empty) while the other ear is folded in and under the flap, which is then reinserted into the carton. Exposed stock is always to be marked "EXP." On large cartons the flap is reinserted into the carton and sealed with tape. On cartons with fold-in "ears" beneath the carton flap, both ears are allowed to protrude (to indicate exposed stock) and only the flap is reinserted into the carton.

3.8b Cans without cartons

Quite often cans of film in a case do not have cartons. Cans of raw stock always have manufacturer's tape on the circumference. Printed on the tape (and on the can label) will be the type, emulsion batch, and roll (cut) numbers.

When raw stock is taken out of a can the manufacturer's printed tape should be removed and thrown away: a film can without tape is empty.

When exposed film is put back into a can the circumference of the can should be wrapped with blank camera tape, and a camera report attached to the lid. The label must now be marked: "Roll No.____ EXP."

When these procedures are consistently followed the one case will accommodate: (a) raw stock with manufacturer's printed tape; (b) empty cans without tape (empties should always be placed between the raw stock and the exposed film); and (c) exposed film with blank tape. With this method all can be distinguished at a glance.

3.8c Cans to lab

When cans of exposed film are *taken* to the laboratory with the original camera reports attached, they are stacked (top one inverted so as to present the bottom up) and wrapped with camera tape. When *shipped* (as from location), exposed-film cans are either placed in individual cartons, taped together, or packed tightly in a case. All empty spaces in the case are stuffed with paper to keep the cans from sliding or bumping.

All shipping cases are secured with camera or Gaffer's tape and prominently marked, on *all* sides:

EXPOSED FILM—KEEP FROM RADIATION.

The amount of insurance placed on shipped film is at the discretion of the production company (rule of thumb: double the production cost required to film the rolls exposed—to pay for the original shoot and a reshoot). A waybill number, carrier name, and flight or route number are obtained and saved until a report (either from the laboratory or the Production Manager) indicates that the shipment has reached its destination.

3.9 THE CHANGING BAG

The changing bag is a "portable loading room" used on location or whenever film must be handled in the dark and a darkroom is not available. The bags are manufactured in several sizes; the larger the bag, the greater the ease of working within it.

Fabricated of canvas (or rubber) enclosed in a black cloth cover, a changing bag is actually a bag within a bag, with its own zipper at the top for insertion and removal of magazines and film. Both layers of material are sewn together along their edges and along the perimeter of two elastic-cuffed sleeves. This arrangement permits insertion of the hands and arms into the sleeves. When the arms are in the sleeves above the loader's elbows (with zippers closed) a lighttight compartment is created for the safe loading and unloading of magazines.

The first rule for working in a changing bag is: Don't panic! Should something go wrong, the loader must *stop*, *think*, and retrace his steps. If necessary, start over from the beginning, but *never* come out of the bag unless the film is safely covered in the film can or the magazine. A loader never allows himself to be rushed no matter how much "hurry up" pressure is applied.

3.9a Preparation

Remove the folded changing bag from its carrying container, unzip both zippers and shake the bag vigorously to remove foreign matter. Turn the bag inside-out before and after each job and inspect for pinholes, rips, and debris. Although the bag is lightproof, avoid using it in direct sunlight. Heat of the sun or light filtering through pinholes in the fabric may damage the film.

3.9b Loading

Spread the bag out flat. The magazine to be used must have a core on the take-up spindle and must have been cleaned thoroughly before placing it inside the bag. *Always* insert the magazine into the bag with the feed side to the left, the take-up side to the right, the light traps toward the loader. The lids must be *on* to avoid the chance of dust, dirt, or debris dropping into the magazine.

Remove the sealing tape from the can of raw stock and place the can in the bag to the *left* of the magazine. Close both zippers, tuck them under the bag, and insert hands and bare arms into the sleeves to a depth past the elbows. Remove the magazine lid and place it *under* the magazine to conserve work area. Lift the cover of the raw stock can, invert the cover and place it *under* the can. Remove the raw stock from the labpack bag and hold the film in the left hand; remove any sealing tape the manufacturer may use to prevent unreeling of the raw stock and apply the tape to the inside of the raw stock can. Load the raw stock into the magazine, then replace the magazine lid and check to make sure it is secure. Remove the arms from the sleeves, unzip the bag, remove magazine. Tape and mark the magazine

according to standard loading-room procedures (Sec. 3.5). Put the labpack bag in the film can and replace the cover on the can.

3.9c Unloading

Unzip the bag, place the exposed magazine inside. Lift the ID tape and place it in the center of the magazine lid. Place the unload can, nested in its cover and containing a labpack bag, to the right of the magazine. Ready the labpack bag. Zip the changing bag, tuck the zippered end under, and insert arms in sleeves to above the elbows. Remove the magazine take-up–side lid. Place the exposed stock in the labpack bag and can, replace the can cover.

CAUTION: Some magazines have reusable cores. Do *not* ship them off to the laboratory!

Unzip the bag, tape the can around its circumference, and affix the ID tape and camera report to the can.

3.9d Folding the bag

Changing bags packaged by the manufacturer are folded to fit a shipping box. Users invariably—and wrongly—fold the bag along the same creases. All zipper and sleeve openings require protection from dirt and snagging. To assure a longer life, cleanliness, and minimum damage, lay out the changing bag as follows (See Fig. 3-3):

(a) Flat, zippers at the top, closed. (b) Fold the sleeves, at the bottom, inward. (c) Bring up the bottom half of the bag side toward the top. (d) Fold the zipper end halfway down to meet the sleeve edge. (e) Fold the right side inward half-way. (f) Fold the left side in to meet the right edge. (g) Bring up the bottom to meet the top. (h) Fold the right side again to meet the left side.

Store the properly folded bag in its zippered carrying container.

NOTE: After each use the bag is shaken out, turned inside-out, and checked for dirt, debris, and damage before folding.

Emergency changing bag. In extreme situations, a *lined* overcoat may be used as a changing bag as follows: Lay the coat out flat, open, buttons up, coattail nearest the loader. Place the can of film and magazine inside. Button the coat, fold it in half over the magazine, collar toward the loader. Tuck the coattail under, and the collar under the coattail. Place the arms in the coat sleeves and work on the magazine.

CAUTION: Use the emergency bag in a dark or heavily shaded area. Throw an extra blanket over the coat to add to its lighttight security.

3.10 HAND TESTS

A hand test (sometimes called a "slop test") is an emergency procedure used when the services of a film-processing laboratory are not available; e.g., when on location. Hand tests are not intended for exposure checks since the processing procedures and control obtained at a commercial laboratory cannot be duplicated by hand.

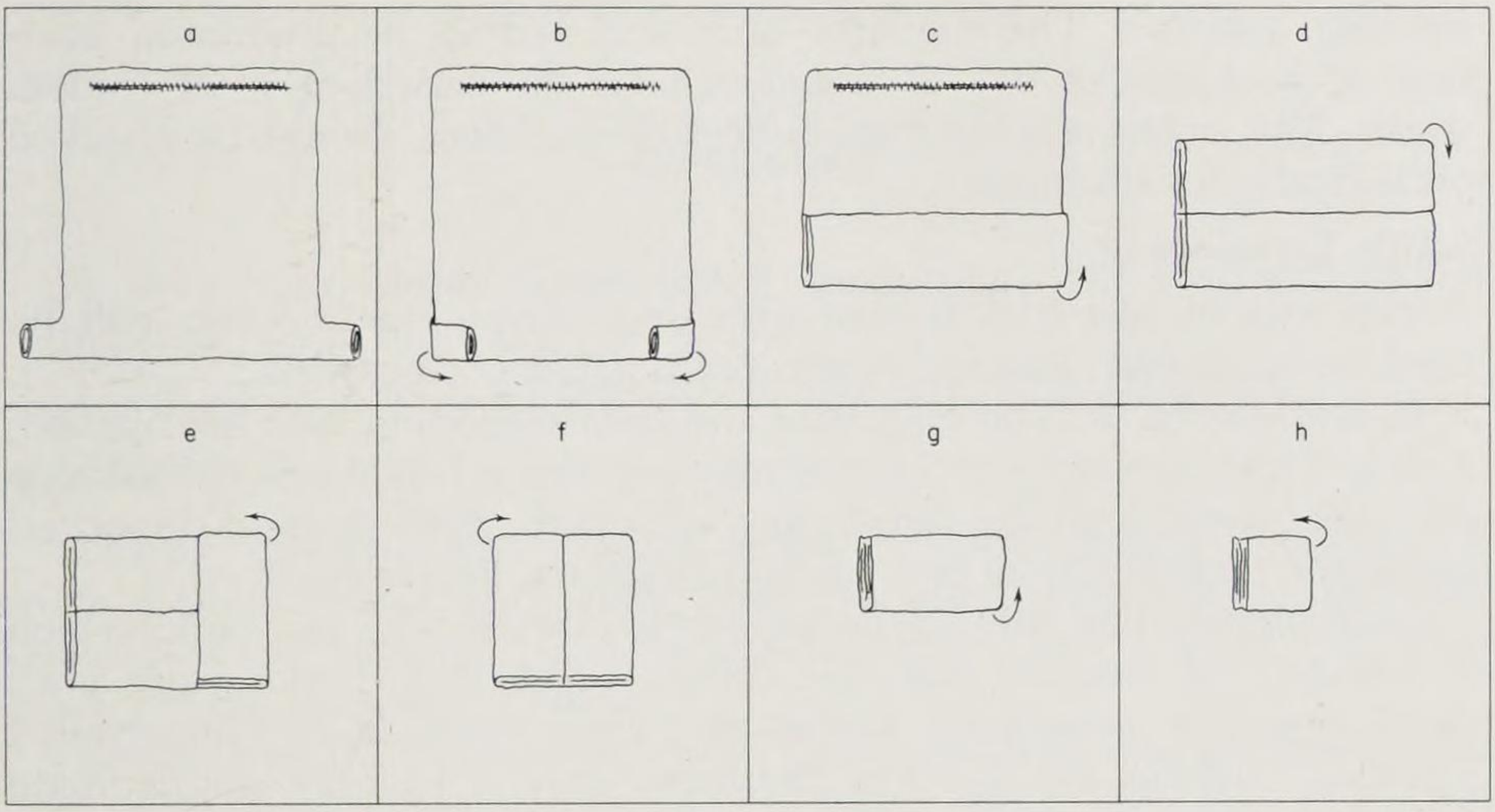


Fig. 3-3. Folding the changing bag.

A hand test is conducted when (1) the accuracy of a camera shutter or the focus of a lens is in doubt; (2) when an effects matte must be cut for insertion in a Mitchell focusing tube to align an object in a previously filmed scene to an object yet to be photographed (e.g., art work to live action, or vice versa); (3) when the identity of an unmarked roll of raw stock must be determined (see Camera Film Identification, Sec. 2.1c, Tables 2-1 to 2-5).

3.10a Chemicals and equipment

The chemicals and implements necessary to conduct a hand test are:

Slop-Test Kit

Chemicals	Equipment
High-contrast print developer (e.g., Ansco Vividol; Dupont 123D; Kodak Dektol)	Daylight-loading developing tank with reel that accepts at least 5 ft of film
Hypo	Quart jars or cups for measuring
Water	

The slop-test kit is considered standard equipment. High-contrast print developer can be purchased as a prepared liquid or made up from a dry chemical. Commercially prepared liquid developers are mixed by the manufacturer at a ratio of approximately 1:10 (dry chemical to water). The prepared solution is then diluted by the loader at a ratio of 1:1 (solution to water) in a minimum quantity of one quart.

If prepared liquid is not available the loader can use the dry chemical by preparing the solution according to the directions on the package. Generally, the mixture is 1:10 for stock solution; the *stock solution* is then diluted 1:1 to yield a minimum quantity of one quart

working solution. The daylight tank and bottles of prediluted solution or packages of dry chemical can be purchased at most camera stores. The expiration date on bottles or packages should be checked periodically for freshness.

3.10b Developing

Ten feet of test film is shot although only a foot or two will be used for each test; excess footage not needed is discarded.

In total darkness: The magazine and the developing tank are opened. A strip (approximately 1–3 ft) of exposed film is broken off the take-up roll and wound onto the developing tank reel. With the reel deposited inside the tank, *both* the tank lid and magazine lid are replaced.

In daylight: The diluted developer is poured into the tank, which is agitated by rotating the reel collar of the tank periodically until development is completed. Developing time varies in an uncontrolled situation such as on location, therefore only a roughly approximate time factor can be given, and experiments should be made.

Approximate Development Time

Color neg.	7 min	Color rev.	7 min
Medium-speed b&w neg.	4	High-speed color rev.	10
High-speed b&w neg.	2	Medium-speed b&w rev.	5
		High-speed b&w rev.	3

With development time completed, drain the tank and rinse it several times with water. Add the hypo and allow the film to fix for a minimum of 5 minutes, agitating the tank often. Drain the tank, remove the lid, and rinse the film in water approximately 10 minutes (30 minutes if the film is to be used as an effects matte).

NOTE: Slopped color film (both negative and reversal) exhibits an overall orange cast when removed from the tank or tray. Color values *cannot* be determined with a slop test.

When practical, it is far better to use a still-photographer's darkroom and trays instead of the daylight tank.

When all tests are completed, dispose of the excess exposed film and thread the unused raw stock onto the magazine take-up core.

CHAPTER 4

Slates

A slate is an identification board containing data pertinent to the production being filmed.

There are two basic types of slates: (1) sync and (2) insert.

4.1 SYNC SLATE

The top of a sync slate consists of two halves of heavy wood painted with diagonal black and white lines (see Fig. 4-1). The upper half (*clapstick*) is hinged at one end to the lower half (*base*), which is nailed to the data board (*slate*).

The data on the slate consists of: (a) Information; (b) Identification.

4.1a Information

NOTE: While position of the lines of information may vary from slate to slate, the basic data written on the board is as follows:

Scene number. This corresponds to the "scene number" in the script or storyboard pertaining to the action. It is also the "scene number" written in the camera report. The number is obtained from the Script Clerk or Director.

Numerals must be written clearly and distinctly. The numeral one "1" is always written as a straight vertical line (I)—no hook at the top or horizontal line at the base. The numeral four "4" is always closed at the top. The numerals six "6" and nine "9" or any combination of digits with a "6" or "9" are always underlined to distinguish the proper base to the numeral. The numeral seven "7" has a straight horizontal top with a vertical stem angled to the left—no hooks or base line. (A very short horizontal bar through the stem—thus: "7"—is optional in the United States, but common practice in Europe and Asia.) A zero (0) is elliptical and closed at the top. Drawing a line through the zero—thus "Ø"—is not practiced in the United States but is common in Europe and Asia.

A "pick-up" (i.e., a short take of the action within the same scene no.) or a variation of the scene for which no number has been established (i.e., different angle, intercut, etc. of the same action within the same scene no.) is slated with the same scene no. and a letter of the alphabet added to it.

When shooting sound, the added letter is always spoken out by the Soundman as a word (e.g., A—Apple; B—Baker; C—Charlie; D—Dog; E—Easy). Letters not used in slating are: I—Item; O—Oboe; Q—Quebec; U—Uncle; Z—Zebra. These letters closely resemble numbers (especially when written hurriedly) and can cause confusion in the Editorial Department; e.g., the letter "eye" ("I") looks like the numeral "one" ("1"); O, Q, and U resemble zero, either closed, with an accidental

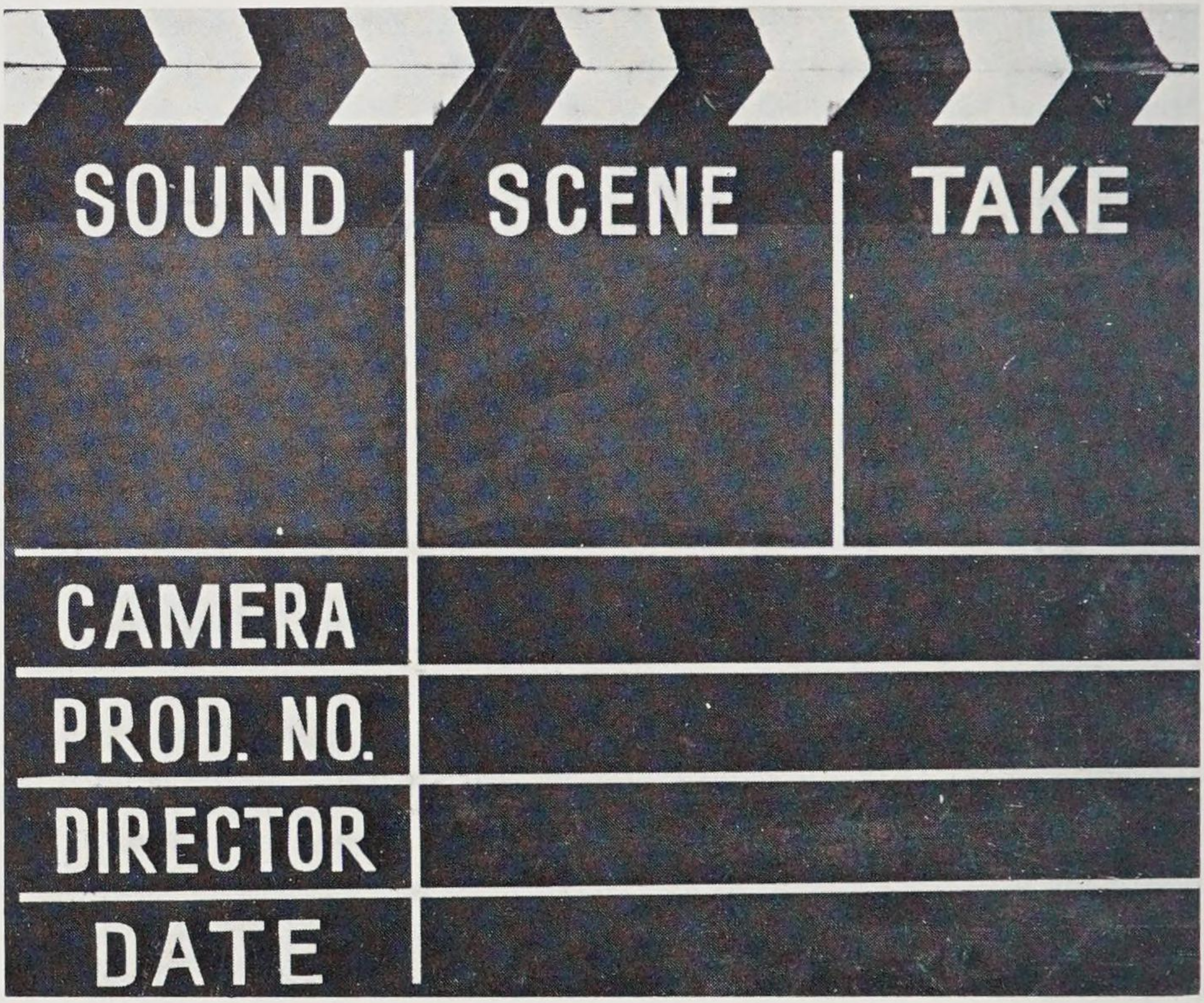


Fig. 4-1. Sync slate.

mark in it, or unclosed at the top; and Z is too similar to the numeral "two" ("2").

If all the letters of the alphabet are used up, then a second letter is tacked onto the first letter (e.g., AA, AB, BA, BB, CA) and are spoken as Apple-Apple, Apple-Baker, Baker-Baker, etc.

Take Number. This corresponds to the number of times the scene is repeated, and is numerically consecutive, until the Director and/or Cameraman decides to change angle or scene. Only when the scene no. changes, or when a pickup or variation of the scene occurs, does the take no. revert to numeral number one (1).

Sound number. Although seldom used, a space for the sound no. is on the slate for the following reason: Regardless of picture scene no. or take no., the first sync sound take is numbered Sd no. 1 (one), and thereafter the sound no. is consecutive throughout the entire production. (Many Film Editors use the sound no. for fast selection of printed takes when preparing to match sound and picture.)

On some productions, the Soundman (Mixer) merely states the sound no. instead of the scene and take nos. and the Slateman (who may be either a First or Second Assistant Cameraman) closes the clapstick (see Sec. 4.2, "Slating Procedure").

When there is no sound on a take, the sound no. is erased and the letters MOS ("Mit Out Sound") substituted to indicate it is a silent take. Everyone in the industry is familiar with the story of the German-accented Director who called "without sound," and the phonetics-minded slateman who started a film industry tradition.

The scene, take, and sound nos. are written in chalk. A reject powder puff obtained from Make-up is a good eraser. The puff may be attached to the slate with string or tucked into a wide rubber band stretched around the slate.

Some Assistant Cameramen make "sets" of numerals with camera tape. Strips 1–2 in. long are numbered "1" through "0" with a felt marking pen, bent over at the top to form a little tab for ease of handling, stuck to the back of the slate, and brought from the back of the slate and applied to the front as needed.

4.1b Identification

NOTE: The following identification spaces on the slots are customarily covered with camera tape which is written on with a felt marking pen to ensure the data will not be erased during production.

Production Number. The production no. is the number assigned to that particular film. Picture title alone is inadequate. It is essential to keep the production no. correct. If scenes from more than one production are being photographed, the production no. must be changed accordingly each time, as it is the Editorial Department's only guide to which production the scenes belong.

Director. The last name of the film's Creative Director.

Camera. The last name of the First Cameraman (Director of Photography). On a multicamera film, the Camera Operator's name may appear beneath the First Cameraman's for identification purposes only; but this is not a rule.

Date. The month, day, and year the scene and take were photographed.

Some sync slates may carry additional identification such as Ext/Int, Day/Night, Produced by. If so, then:

Ext/Int; Day/Night. A check mark of one of each pair indicates to the Timer in the laboratory the lighting of the scene. He refers to the camera report for more specific details. (See "Remarks" in Secs. 5.1b and 5.2b).

Produced by: The name of the *company* (not the individual) producing the film.

4.2 SLATING PROCEDURE

Some production companies prefer to have the head of each roll slated with a roll no. and, on multicamera films, the camera no. as well. In each instance the roll and/or camera no. is written on the back of the slate (which is then presented to the camera)—never on the face of the slate.

The scene, take, and sound nos. are obtained from the Script Clerk or the Director. The face of the slate is then held in such a position that the Sound Mixer can see and verify the numbers. Once these are acknowledged, the Assistant Cameraman then turns the slate toward the camera.

It is the Camera Operator's responsibility to frame the slate properly so that it may be read through the camera viewing system and thus on the developed film. His directions to the Assistant are: "up," "down," "camera left" (which is to the Slateholder's right), "camera right" (to the Slateholder's left), "upstage" (away from camera), "downstage" (toward camera), "flare" (which calls for the top of the slate to be tipped forward to eliminate unreadable "bloom" [light striking the slate] across the data), and "clockwise" and "counter-clockwise" (which refer to moving one corner of the slate toward the camera so as to place the slate more squarely to the Operator).

The hinged upper half of the slate painted with diagonal lines (*clapstick*), is utilized for synchronized-sound takes by raising it and bringing it down sharply against the lower half (*base*). The visual meeting of the two halves on film, when matched to the aural signal on tape, provide the Film Editor with synchronization marks for sound and picture. Since the Editor must determine the exact moment of impact visually, it is imperative that a proper slate be recorded on film.

An Assistant Cameraman new at slating invariably moves the slate downward as he lowers the clapstick. The resultant blurred image causes unnecessary work ("syncing takes") in the Editorial Department. The proper way to execute a slate is to grasp the bottom of the slate in one hand, and the clapstick in the other. At the command to "roll film," the clapstick is raised to show the Editor it is a sound take, and also that it is prior to the sync marks. After the Soundman has called the sound, and/or scene and take number(s) the clapstick is brought down sharply and positively, and not allowed to bounce open. The hand at the bottom of the board prevents the slate from moving downward and blurring the image. The slate, with clapstick closed, is held motionless for about one second, then swiftly swung down and out of frame.

The clapstick is never opened under any circumstances when shooting an MOS shot. Doing so will invariably institute a search by the Editorial Department for a sound take in spite of the "MOS" written on the slate. It will be assumed the Assistant Cameraman forgot to erase the "MOS" and that a sound take *was* rolled.

An Assistant Cameraman never allows himself to be hurried while slating, but once the information has been recorded on film he moves fast to clear the scene.

Should the clapstick be improperly photographed, or missed by the Operator, the slate is reinserted into the scene and a loud command "Second Marker!" shouted before hitting the clapstick again. This tells the Editor that the first clapstick noise on the tape is unusable and

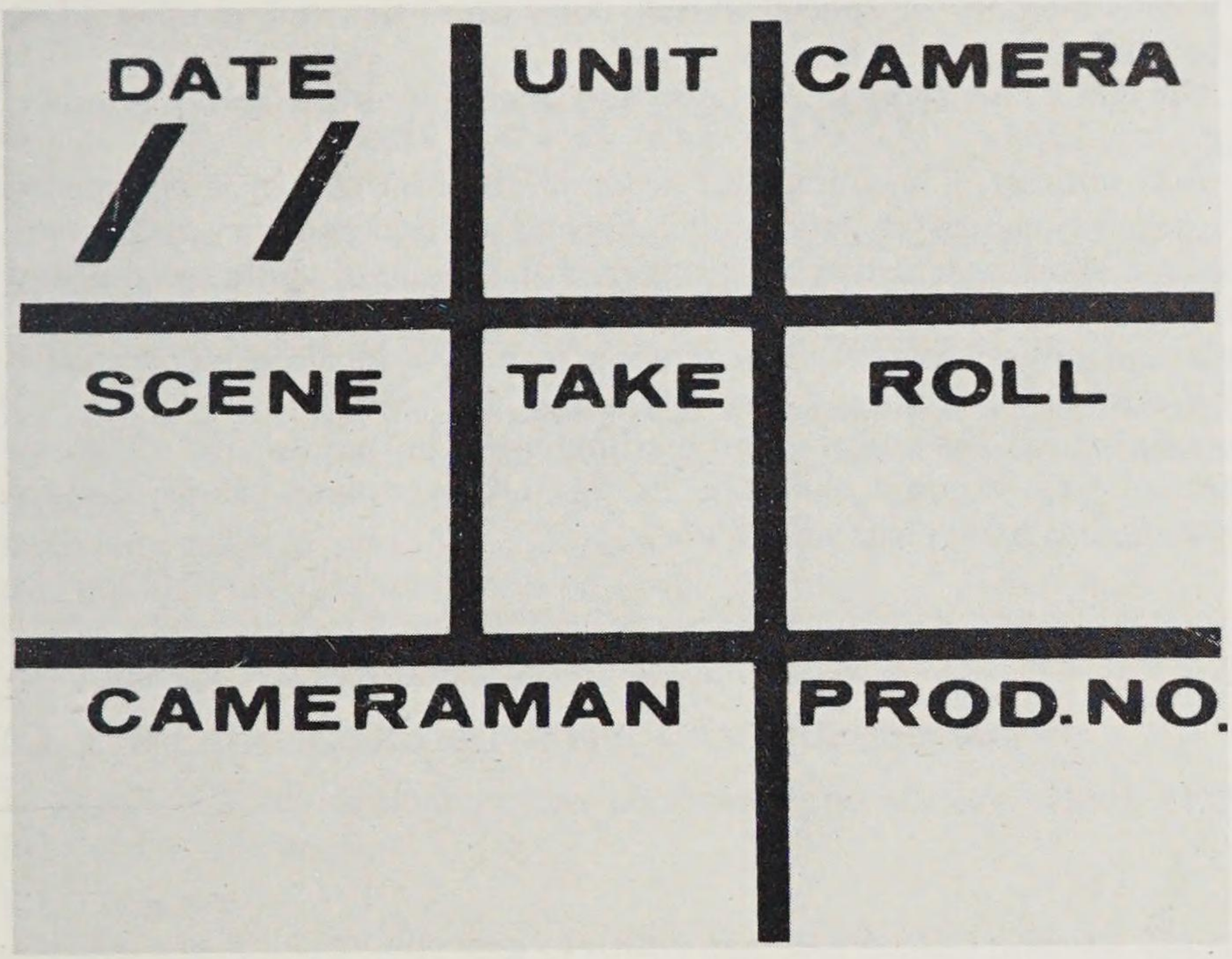


Fig. 4-2. Insert slate.

that the correct sync mark is the second marker noise as called by the Assistant (or Soundman).

Tail slate. In some instances, a slate cannot be photographed at the head of the scene. When the action for the picture has ended, the camera and recorder are kept running. The slate is presented to the camera *upside down,* the clapstick opened until the Soundman calls "Tail slate!" and the sound no. or scene and take nos. The clapstick is then brought *up* sharply and positively, and not allowed to fall open.

4.3 INSERT SLATE

The insert slate is a small pocket-size identification board (see Fig. 4-2) without a clapstick. It is most often required when filming MOS, or, as the name implies, for inserts on a sound stage when long lenses are used and for which the large standard slate is impractical. The information and identification data are essentially the same as on a sync slate, with the following exceptions:

Unit. The number assigned to the group doing the photography. Various crews of Directors, Cameramen, Grips, and Electricians may be assigned to filming certain segments of one film. A second unit is virtually standard on theatrical films, and it is quite common for third, fourth, fifth (and sometimes further) units to be shooting a

TV documentary or special at the same time—the unit number identifies each group in such cases.

Camera. The type of camera and manufacturer's serial number; e.g., Arri 1254.

Roll number. The numerical order of the film roll as it is exposed during the course of production. Second or documentary units may place a short descriptive title rather than numbers in the scene- and take-number spaces. A series of scenes will be filmed under this short title and only changed when moving to a new location or sequence. Roll nos. on the film and corresponding "Cap Sheets" (see Sec. 5.3) containing all the information pertinent to the scenes and takes on that roll are the only clues the Editorial Department has to identify location and relevance to the film.

CHAPTER 5

Camera Reports

A Camera Report is a sheet or card providing data pertinent to a particular roll of exposed film. Two or three carbon copies are made.

There are three basic types of camera reports:

1. Clipboard-type or vertical format; this report hangs on a clipboard which is to be placed below the camera dolly or tripod, or may be taped to the back of the slate. 2. Magazine-type or horizontal format; this report is inserted in a holder on, or is taped to, the magazine take-up side. 3. Caption sheet (often called "dope sheet"); this report is used for films with no script.

The data on a Camera Report is divided into three sections: (a) Identity; (b) Information; (c) Inventory.

5.1 TYPICAL CLIPBOARD-TYPE CAMERA REPORT

Entries in the sections of the clipboard-type camera report (Fig. 5-1) are as follows:

5.1a Identity

Date. The month, day, and year the film was loaded into the magazine. If, in an extreme situation, a partially exposed roll must remain in the magazine overnight (a bad practice—all exposed film should be canned and processed as soon as possible), a line is drawn in the information section, and the new date written below the line.

Company. The name of the production company.

Address. The billing address of the production company. If the processed film and/or prints are to be shipped to any address other than the billing address (i.e., to the screening room, editorial services) the notation "SHIP (print only) (negative only) (print and negative) TO: (fill in other address)," is written in the information section in addition to a notation on the purchase order that accompanies the exposed film.

Production. The production no. assigned to that particular film. Picture title alone is inadequate. During heavy scheduling of a TV series, or a group of commercials covering a given product, the Editorial Department has little time to figure out which film a scene or roll belongs to. The production no. leaves no doubt.

If more than one production no. is slated on one roll, the *first* production no. slated is placed in the identity section; thereafter any different production no. precedes its scene no. (e.g., 6844–"scene no." 6, "takes" 1 and 2 in Fig. 5-1) and is placed in the *information section* (see "Scene Number" in Sec. 5.1b). A scene no. *not* preceded by a production no. belongs to the production no. placed in the *identity section* (Sec. 5.1a).

Director. The last name of the film's Creative Director.

462-0881 469-1441 DATE FILM LOADED
Date IN MAGAZINE

Company C.S.F. PRODUCTIONS

Address 897 STUDIO ST CITY

Production #6845

Director SALLAND Cameraman CARLSON

Magazine No. 427 Roll No. 14

PRINT CIRCLED TAKES — PLEASE CIRCLE ONE — (COLOR) BLACK & WHITE — KIND OF FILM 5254-ECN

SCENE NO.	TAKES 1 5	2 6	3 7	4 8	DAY OR NIGHT	Remarks	INT. OR EXT.
71			20 (7)	(60)	DAY		INT
72	10	(50)	(70)			TKS 1-6, ROLL 13	
74	(40)	30	(40)			EFFECT	
19	10	—	(50)	40		TK 3 TL SLATE	
	20	60	(40)			NO TK 2	EXT
6844-6	(60)	(50)				PRT FOR NITE	
76A	40	30				" " "	
21	(30)	[20]	(40)				
20	(10)	[10]	(10)	(10)			
76A			[40]	(50)	DAY		EXT
77A	(40)					TKS 1+2 ABOVE	
					DAY	SERIES	INT

20 80 90 140 210 250 280 320 330 380 420 440 500 540 600 650 690 720 750 770 810 820 830 840 850 890 940 980

Out at 980'

SHIP PRINTS ONLY TO:
552 CINE ST
CITY

No. Cans to Lab. (7) Bal. Neg. on Hand 4000

Good Footage 680 Received 18000

N.G. Footage 300 Exposed 7000

Waste Footage 20 On Hand 15000

Total Footage 1000 Emul. No. 334-22-16

Fig. 5-1. Typical clipboard-type camera report. Courtesy of Consolidated Film Industries.

Cameraman. The last name of the First Cameraman (Director of Photography).

Magazine number. The serial no. assigned the specific magazine by the manufacturer. Some manufacturers stamp a number on their emblem or close to the magazine throat. The inscribed serial no. takes precedence over any stenciled or painted digits on the magazine, since these numbers may be duplicated when two or more magazines are assigned to one camera. Knowing the manufacturer's serial no. (which is never duplicated) aids in tracing any malfunction (scratches, edge fog, etc.) that may appear on the processed roll. Magazines with no manufacturer's number are, of course, assigned a number by the loader.

Roll number. The numerical order of the magazine as it is placed on the camera in the course of production.

Whenever a roll is broken and the unexposed portion threaded into the take-up, a new roll no. and camera report are assigned to that portion of film remaining, regardless of its length.

The laboratory will assemble the rolls in their numerical order before returning the prints and/or the negatives to the production company.

NOTE: The negative is usually held at the laboratory or sent to the negative cutter. The prints are sent to the editor at the production company.

Some, but not all, camera reports are printed with a "COLOR/B&W" raw-stock designation. The appropriate designation is circled in addition to:

Kind of film. Both the type no. and the common name (e.g., 4231 PXN; 930A–Rap Rev.; 2531 Versapan). The type no. and common name serve as a double-check when canning the film, and also for the Laboratory Technician when he prepares the film for development.

The use of the common name alone can cause confusion and possible error when processing in the laboratory: e.g., "Color"; the laboratory needs to know if a can is to be placed on the 35mm or 16mm processing line. While one canned 16mm single roll is readily distinguishable, a 35mm can may contain either one or two 16mm rolls (a bad practice), or one 35mm roll. Also, "Color" does not indicate if the can contains negative or reversal stock, which is manufactured in both widths, and different ASA indexes. The film must be set aside until the laboratory has time to discover what type and size film has been sent to them—a delay in processing and the cause of unnecessary work.

5.1b Information

Scene number. Corresponds to the number on the slate, and number or description in the script (or picture on a storyboard).

Takes. Only the *footage expended* on the take is entered, not the take no. or dial (footage-counter) reading.

When using a camera with an additive dial, the Operator rounds off his dial reading to the nearest 10 ft when using 35mm film (nearest 5 ft when using 16mm) and gives the Assistant only the first two digits (e.g., 213 ft is called "21"; 379 ft is called "38"; 675 ft. is called on the long side—"68").

As the numbers on the dial increase, the Assistant must subtract the *previous* reading from the new reading in order to determine the footage expended on the take.

Because a clipboard-type camera report has no provision for a dial entry, the dial reading given by the Operator must be either written along the right-hand edge of the report or calculated on a separate sheet of paper.

When using a camera with a subtractive magazine indicator, the amount of footage expended must be estimated since the indicator is not as accurate as a digital footage counter. When using color film, it must be remembered, the indicator will show approximately 10 per cent more than actually remains on the roll (due to thickness of emulsion). As the indicator decreases, the Assistant must subtract the *new* reading from the previous reading in order to determine the footage expended on the take.

The footage expended on each take is placed in its appropriate space and as each line of four takes is filled, the next line below is used for succeeding takes (e.g., "scene no." 19, in Fig. 5-1).

A carryover of takes from a previous roll (e.g., "scene no." 71, "take" 7, in Fig. 5-1), while placed in its appropriate space, also has a take no. in the upper right-hand corner to indicate to the Lab and Editorial Department that it is a carryover and that there are no other takes ahead of that number on that particular roll.

Any time a take is less than 10 ft in length and is a "no print," or if the camera has not run but the Soundman has voice-slated his tape thereby requiring that the next take no. be used on the slate, a straight line (—) rather than a footage count is inserted (e.g., "scene no." 19, "take" 2 in Fig. 5-1). If less than 10 ft in length and a "print," it is given a minimum count of "10."

A circled take indicates to the laboratory that the particular length of film is to be printed for screening (e.g., "scene no." 71, "take" 8 in Fig. 5-1).

All "holds" are squared (e.g., "scene no." 76A, "take" 3, in Fig. 5-1). The square indicates to the Editorial Department that the take is acceptable to the Director even though the circled take is preferred. Laboratories will print a "hold."

Takes and holds marked for printing and then later rejected after being circled or squared are canceled out by drawing short lines through the circumference of the circle (e.g., "scene no." 20, "take" 1) or the sides of the square (e.g., "scene no." 21, "take" 2 in Fig. 5-1).

Remarks. This section is important to the Laboratory Timer as well as the Editorial Department.

The "DAY/NIGHT" and "EXT./INT." notations often make the difference between a mediocre print and the very essence of the First Cameraman's intent when timed dailies are desired. Without the proper information to the Timer, a day-for-night scene (e.g., "scene nos." 19, 20, and 21 in Fig. 5-1) may appear underexposed, or the Timer may choose the wrong printing light in an attempt to save what he feels to be an incorrectly exposed scene. The print will be wrong, the recommended printing light will be wrong, the production company will have to have the scene reprinted (cost and delay), and the First Cameraman will be displeased with the treatment of his effect.

Any special effect (focus change, lights on, lights off, etc.) is noted as "Effect" (e.g., "scene no." 72, "takes" 1, 2, Fig. 5-1).

Previous takes of a scene no. located on another roll are noted for the Editorial Department (e.g., "scene no." 71, "takes" 1–6, Fig. 5-1).

All tail (or "end") slates are noted (e.g., "scene no." 19, "take" 3, tail slate) so that the Laboratory Technician who reads the camera report will know which takes to "pull." He separates the circled and squared takes from the developed negative and makes prints from them. Since the Technician only uses the photograph of the slate as a guide to separate his "good" from "no good" takes, the notation warns him to look for a different picture or clear frame (which denotes a camera stop) instead of a slate. The Editorial Department makes use of the notation also, when it is assembling the print.

All silent takes are noted MOS to indicate to the Laboratory and Editorial Department that no sound accompanies the picture.

When there are no prints of a particular scene (e.g., "scene no." 76A, "takes" 1, 2, Fig. 5-1), a definite "No Print" notation is mandatory, since the Laboratory and Editorial Department have no way of knowing if it is a "No Print" or if the Assistant forgot to circle a take. Telephone calls, searches, and delay in delivery of prints to the production company will thus be avoided.

A number of takes shot on one slate is noted as "Series" (e.g., "scene no." 77, "take" 1, Fig. 5-1) so that the Editorial Department will know to expect more than one take of the same action.

At the end of the roll, or at the end of the day's shooting, the information section of the report is reviewed with the Script Clerk or Sound Recordist to verify all prints and holds.

5.1c Inventory

Divided into two columns at the bottom, the left side is completed on each report. With the exception of the emulsion no., which is also written on each report, the right side is completed on only the last report of the day.

No. cans to lab. The circled digit in the "No. Cans to Lab." space indicates the number of exposed rolls sent in that day.

Good footage. The total of the circled and squared takes in the information section.

N. G. (no good) footage. The total of "No Print" takes in the information section.

Waste footage. The total of the unexposed footage too short to be canned as a short end, and therefore thrown away.

Total footage. The sum of Good Footage, N. G. Footage, and Waste Footage.

Balance of negatives on hand (raw stock). Corresponds to the total raw-stock inventory at the end of the previous day's shooting. A straight line (—) would indicate no raw stock remained, or was available, the previous day.

> NOTE: To be technically correct the term "negative" is any processed film that possesses a negative image to which it was exposed. Prior to USASI's Standards on Nomenclature (see PH22.56-1961, Sec. 2.1) raw stock was often called "negative" and this is reflected in the camera report.

Received. The total raw-stock supply received by the Assistant Cameraman that day.

On hand. The total raw-stock footage remaining after the "exposed" stock has been subtracted from the sum of "bal. neg. on hand" and footage "received." (The amount of footage remaining becomes the next day's "bal. neg. on hand.") A straight line (—) would indicate no raw stock remained.

Emul. no. The manufacturer's emulsion no. and roll no. (as on the raw-stock can label) and the can no. (See Sec. 2.1 and Tables 2-1–2-5.)

5.2 TYPICAL MAGAZINE-TYPE CAMERA REPORT

Entries in the sections of the magazine-type camera report (Fig. 5-2) are as follows:

5.2a Identity

Cameraman. The last name of the First Cameraman (Director of Photography).

Director. The last name of the film's Creative Director.

Picture no. The production no. assigned to that particular picture.

Camera no. The type of camera and the manufacturer's serial no., e.g., BNC #164.

Mag. no. The serial no. assigned the specific magazine by the manufacturer.

Footage. The total amount of raw stock loaded into the magazine.

Loaded. The date (month and day) the magazine was loaded.

Loader. The initials of the person who loaded the magazine.

Emul. no. The manufacturer's emulsion no. that is printed on the raw-stock can label.

Cut no. The *manufacturer's* roll no. (often—and mistakenly—called a "cut number" or "slit number") that is printed on the raw-stock can label (see Sec. 2.1 and Tables 2-1–2-5).

FORM 185 10M SETS 8-64

CAMERAMAN CARLSON DIRECTOR SMITH PICTURE NO. ROLL 7 7180

CAMERA BNC-164 MAG. NO. 48 FOOTAGE 1000 LOADED 4/8

LOADER G.S. EMUL. 334 CUT NO. 17 204672

CAN NO. 34 TYPE FILM 4231 - PXN EXPOSED 990' EDGE 239685 987

SCENE NO.	SHOT NUMBER SILENT	SHOT NUMBER SOUND	DIAL FEET	REMARKS
15		80	80	DAY INT
		60	140	
		(80)	220	
		(70)	290	
17A	(50)		340	NITE INT PRT FOR NITE
	[50]		390	PRT FOR NITE
	(50)		440	PRT FOR NITE
15A		(110)	550	DAY EXT
		(100)	650	
136		40	690	DAY INT
		50	740	
		(40)	780	

SCENE NO.	SHOT NUMBER SILENT	SHOT NUMBER SOUND	DIAL FEET	REMARKS
136		(50) (4)	830	DAY INT TL SLATE TK 4
16		(40)	870	DAY INT
		(40)	910	
17	[40]		950	NITE EXT EFFECT
	(40)		990	EFFECT
	GOOD	710'		
	NG	280		
	WASTE	10		
		1000		

BW Nº 14152 COLUMBIA PICTURES

Fig. 5-2. Magazine-type camera report. Courtesy of Columbia Pictures Corp.

Can no. The number written by the *manufacturer* on the can or on the carton in grease pencil.

Type film. Both the *manufacturer's* type no. and the common name.

Exposed. The total amount of raw stock exposed and registered on the dial (footage counter) and rounded off to the nearest 10 ft in 35mm; nearest 5 ft in 16mm (see Sec. 5.1b, under "Takes," for detailed instructions).

NOTE: The numerical order of the roll as placed on the camera during production is written in above the "picture no."

5.2b Information

Scene no. Corresponds to the number on the slate and scene no. or description in the script or storyboard.

Shot no. Same as "Takes" in the clipboard-type report (in Sec. 5.1b), but running vertically.

EXCEPTION: The actual footage expended on an MOS shot is entered in the "silent" column.

Dialogue or sound effects are noted in the sound column.

Dial feet. The cumulative footage as registered on the camera dial (footage counter) rounded off to the nearest 10 ft.

Remarks. Same details apply as in "Remarks" in the clipboard-type report (Sec. 5.1b) with the exception of "MOS," as noted (see "Shot No." above).

5.2c Inventory

Edge. On the middle line opposite the word "Edge," the starting edge no. on the roll of b&w raw stock should be noted (see Sec. 3.5 for details on how to determine this).

When the film is returned to the loading room, the last film-edge no. on the film extending from the take-up side of the magazine chamber is written on the line above the starting edge no. An *exact* count is then obtainable by subtracting the first edge no. from the last.

The total of the "Good," "N.G.," and "Waste" Footages are noted on the face of each report.

5.3 TYPICAL CAPTION-SHEET–TYPE CAMERA REPORT

NOTE: The caption-sheet–type camera report ("cap sheet" or "dope sheet") is used primarily when shooting without a script, as when for news or documentary films.

Entries in the sections of caption-sheet–type camera report (Fig. 5-3) are as follows:

5.3a Identity

Date. Month, day, and year the film was *exposed*.

Crew. Either the name or number assigned to the unit or the last name of the Cameraman.

Stock. Both the *manufacturer's* type no. and the common name.

ASA. The exposure rating given the film *by the Cameraman* (which may be double, triple, or quadruple the manufacturer's recommended rating).

Location. The city or area in which the filming is done.

Footage. The amount of *exposed* film being sent to the laboratory.

Subject. The particular person(s) or material the film is about.

Roll number. The numerical order of the roll of film exposed during the production. It is essential to film a roll no. so as to enable the Editorial Department to find, identify, and place the scenes in proper context in the film.

Lab. no. A control no. assigned to the roll by the Laboratory. This number is not filled out by the cameraman because the Lab. no. is not assigned to the roll of film until the day it is developed by the laboratory—which might be days or weeks after it was exposed. A Cameraman has no control over the laboratory or its particular numbering system.

5.3b Information

Shot description. The contents of the scenes on the roll. This includes the type of shot, i.e., MS, CU, Zoom, names of the persons or materials in the shot, the action taking place, and screen direction of subject (left to right, tailaway, right to left, etc.).

DATE TODAY'S DATE

UPI NEWSFILM

CAMERAMAN'S DOPE SHEET

LAB. No.

CREW: UNIT #4 STOCK: DXN 7222 ASA: 500

LOCATION: SAN FRANCISCO FOOTAGE: 370'

SUBJECT: BRIDGE PAINTERS

Roll No.	SHOT DESCRIPTION
6	L.S. BRIDGE FROM SEA, S.F. IN B.G.
	M.S. BRIDGE TOWER
	M.S. SUSPENSION CABLE – DECK LEVEL
	M.C.S. WORKMEN CLIMB CABLE
	C.U. WORKMEN IN + OUT OF FRAME TOWARD CAMERA
	M.S. FROM TOWER – WORKMEN CLIMB UP
	M.C.S. WORKMAN SLINGS BOS'N CHAIR – ZOOM IN
	M.S. PAINTER IN BOS'N CHAIR LOWERS SELF
	L.S. FROM DECK LEVEL – PAINTERS UP HIGH
	L.S. PAINTERS P.O.V. FROM UP HIGH
	CUTAWAY TRAFFIC ON BRIDGE
	" S.F. BUILDINGS IN B.G. PAN LEFT
	" TOLL GATE
	Out at 370'

FILL OUT ABOVE COMPLETELY AND ACCURATELY. ATTACH ALL AVAILABLE BACKGROUND MATERIAL.
SHIP WITH FILM IMMEDIATELY VIA AIR EXPRESS TO: UPI NEWSFILM, 448 W. 56th ST., N.Y. 19, N.Y.

Fig. 5-3. Typical Caption sheet report. Courtesy of UPITN.

5.3c Inventory

The total of all the film *exposed that day* is written on the last sheet only.

5.4 DISPOSITION OF REPORTS

Every roll of film must be accompanied by a camera report even though no slates are shot and the roll is a "print all." This is important should the negative turn up with a defect after processing. An investigator can more easily pinpoint the source of the defect if he has the film, emulsion, can, magazine, and roll nos.

> NOTE: It is also standard procedure for a laboratory to "print all" when no camera report accompanies the can. (They assume every frame is desired, having nothing to indicate otherwise.) An unnecessary printing expense may be incurred (e.g., if only a 20-ft print on a 1000-ft exposed roll is desired, a report would indicate this—no report would result in 1000 ft of print, 980 ft of which would be unusable).

The original white sheet is folded in half and taped face up to the can of exposed film (so the laboratory can read at a glance the company name and type of film). All the carbon copies are considered "hot" and should be presented to the Assistant Director (or the Camera Department Head) immediately after canning exposed film so that they may be distributed to the various departments which depend upon the data.

The Assistant Director sends the second sheet to the Editorial Department and the third sheet is retained by the Assistant Director for his daily Production Report. Other copies (called "accounting sheets") are sent to other departments (accounting, camera, etc.)

NOTE: The reports herein are representative only. A given laboratory's or studio's reports may vary, with more or less data, carbons, size, or format, depending upon circumstances peculiar to its operations. No endorsement or criticism of any laboratory, studio, or format is here intended by inclusion or omission.

CHAPTER 6

On-the-job Procedures

Many in-plant units, television stations, small production houses, and similar groups require their Operative Cameramen to perform what are, in the major film studios, the duties of the Assistant Cameraman. These are functions that all Cameramen, regardless of status, or place of employment, must know, and know well, if they are to work effectively on their own assignments.

The following is a detailed exposition of the procedures and responsibilities of the Assistant Cameraman.

6.1 PRIOR TO SHOOTING

6.1a Preshooting inventory

The Assistant Cameraman is responsible for collecting and checking out the camera and related equipment. A checklist itemizing the equipment needed to "build" the camera unit from the ground up greatly facilitates the performance of this assignment. This, incidentally, is not a figure of speech. The photographic system is properly assembled "from the ground up," with the spreader or tripod as starting point.

Checklist. A basic checklist to guide the Assistant should cover the following items: spreader, tripod (or tripods), tripod head, camera, motor, power line, magazines, lenses, filters, accessories, raw stock, slate, camera reports, empty film cans, and labpack bags.

Location jobs require the following additional items: changing bag and shipping cartons and labels.

> NOTE: It is the responsibility of the Producer to provide raw stock, camera tape, masking tape, camera reports, filters, shipping labels, black labpack bags, extra film cans, and packing cases but their inclusion in the preshooting inventory is the responsibility of the Assistant Cameraman.

6.1b Setting up

The camera is first set up without the magazine; the mechanism is oiled, power line connected, and the camera run unthreaded to warm up the motor and camera. On cold stages or exterior locations, a rule of thumb calls for starting the camera with the footage counter at zero and running it until the counter indicates at least the amount of footage equal to the magazine that will be on the camera. Temperature variations influence the amount of warm-up time, and call for judgment on the part of the Assistant Cameraman.

While the camera warms up, the *slate and camera reports* are prepared with appropriate identification. "Marking-tape strips" for actors are also readied (see Sec. 6.2a).

The *lens case* for a dolly-mounted camera is always kept on the front running board, the slate next to it. The Assistant's ditty bag (tool kit—see Sec. 6.4) is hung below the camera, the magazine and accessory cases kept as close to the dolly as practical.

NOTE: On sound stages a camera equipment case with both latches closed indicates it is empty and not in use. With only one latch closed, it is "working," i.e., being entered for lenses, magazines, accessories, etc. (and therefore is to be kept close to the camera). No latches closed means a careless Assistant Cameraman is on the job (the possibility of the contents of the case being spilled onto the stage floor is great, especially when a new setup is called for and everything must be moved).

Unless the First Cameraman calls for a lens of a specific focal length, *the first lens mounted "up"* is a wide-angle so that the First Cameraman and Director can observe as much of the set as possible to determine lighting, composition, placement of personnel (or product), or the lens required for the shot.

NOTE: *Whenever* a new lens is "brought up," the aperture is set at its widest opening, and the *approximate* distance from camera to subject is set so that the First Cameraman and/or Director can view the scene in focus.

The courtesy of requesting permission of the First Cameraman to *"load camera"* is more to inform him that the camera will be unavailable to him for a short time, rather than the act of a subservient crew member. If the First Cameraman does not need the camera for checking his composition and/or lighting arrangements, he will grant permission to load.

Short-load reminder tape. When a magazine containing less than a normal load of raw stock is placed on the camera, a "reminder tape," i.e., a short strip of white camera tape, is placed at the rear of the camera (below the footage counter) showing the amount of raw stock in the magazine so that the Operator is aware at all times of the short load.

6.1c Film-scratch test

Once the camera is threaded, a *film-scratch test* is made. With the camera door open, approximately 2 ft of film is run past the gate. On double-compartment–type and coaxial-type magazines, the take-up lid is removed and the film unwound from the core. (Displacement-type magazines require reversing the camera and running the film back out.) The surface of the emulsion and base are examined by holding the film surface at a 90° angle to a light source and the film tilted (toward and away from the observer) so as to cause the light to "skip" along the surface. A scratch will be apparent immediately.

To determine where a camera scratch originates, the Assistant runs film through the threaded camera. He stops the camera and with a felt pen marks the film at the following points: (1) where it exits the feed

rollers; (2) before it enters the gate; (3) after it exits the gate; and (4) where it enters the take-up rollers. He then unthreads the camera very carefully and examines the film. The area causing the trouble is indicated by the origin of the scratch on the film. The suspect area is carefully checked for film chips, emulsion build-up, dirt, or burrs on the mechanism. Burrs are removed with crocus cloth, while other offenders are removed with an orangewood stick (not metal!).

6.1d "Hair check"

After a camera has been threaded and a few feet of film "run-in," a *"hair check"* is made. Any lint, dust, and film chips in the camera aperture photograph as large ropes, therefore careful examination of the camera aperture at the first threading and subsequently after each "print" is mandatory.

NOTE: There are three schools of thought on "hair checks": "pull-the-plate" advocates, "pull-the-lens" advocates, and "sight-through-the-lens" advocates.

Some First Cameramen prefer the Assistant to "pull-the-plate," i.e., open the camera door, clear the registration pins and pulldown claw, remove the film from the race, pull the removable plate, and check it. Theoretically, any "hair" will be caught in the recess of the plate, but this does not always work out in practice. It has been the sad experience of many Cameramen (author included) to print a supposedly "clean take," only to discover when screening rushes that a "hair" had left its indelible mark. When the film was removed from the race, the "hair" came out with it, and had escaped detection. The plate came out "clean."

"Pull-the-lens" advocates prefer the Assistant to remove the "taking" lens, clear the shutter from the aperture, and shine a flashlight into the lens port. The film emulsion acts as a bright backing, clearly outlining any "hair" in the aperture. Also, on cameras with deep-set apertures, anything resting in the depth of the aperture (which would be missed by "pulling the plate") can be seen clearly. The primary objection to this method is that one must disengage the follow-focus gears and recheck parallax upon reinsertion of the lens.

The "sight-through-the-lens" method—the author's preference—is accomplished by clearing the shutter from the aperture, leaving the lens in the port, opening the lens to its widest aperture, placing a flashlight to the observer's cheekbone, and, sighting along the barrel of the flashlight, shining the beam into the lens. By moving the head and flashlight *together*, the magnified aperture is easily traced. While somewhat difficult to accomplish at first, once learned—sighting along the light and moving head and light together—this method is quickest and far more reliable than any other the author has used. If the area is clean, no lens removal is necessary. If a magnified "hair" is present, of course, the lens must be removed from the port. This method can only be used on 40mm lenses or longer. Anything shorter than 40mm requires pulling the lens, as magnification is poor.

.1e Cleaning the aperture

To clean the aperture, a bulb syringe is inserted into the port and ently squeezed to blow the area clean. Stubborn lint or chips will

require the insertion of an orangewood stick (never metal) for their removal. With the obstruction removed, a short burst of film is rolled through the camera while observing the aperture to be certain no more hairs drop in before the lens is replaced.

6.1f Parallax check

A *parallax check* is made, with the cooperation of the Camera Operator, on cameras fitted with offset viewfinders. The procedure is repeated each time a different lens is "brought up." On cameras fitted with a follow-focus attachment, the lens and follow-focus cam gear are both first set at infinity. The cam, matching the focal length of the camera taking lens, is placed on the viewfinder harness. The follow-focus and lens gears are then meshed and secured. The viewfinder ribbon mattes are then conformed to match the lens "up."

With the lens set at infinity, the Assistant Cameraman hooks his measuring tape to the camera, steps out to a distance of 15 ft, paying out the tape. He then pulls the measuring tape taut (parallel to the floor), places a finger on the 15-ft mark, lifts the tape vertically—approximately 18 in.—and holds it motionless. The Operator sights through the racked-over camera focusing tube, aligns the focus tube vertical cross hair with the vertical measuring tape, then rotates the follow-focus knob to align the vertical cross hair of the offset viewfinder with the vertical tape. (With no follow-focus attachment on the camera, the lens focus would be set at 15 ft and the Operator would manually move the viewfinder to align the cross hair and lock it in position.) The Assistant Cameraman remains motionless until the Operator compares the focusing tube and viewfinder cross hairs once more. When the Operator says, "set," the Assistant walks to the camera and verifies the lens focus at 15 ft. Any large variation requires checking to see whether (1) the correct cam is mounted on the viewfinder; (2) the viewfinder reducing lens is on (or off), depending on the lens "up"; (3) the viewfinder is properly riding the cam roller; or (4) if one tooth of the lens gear needs to be shifted. Often the "witness mark," i.e., the white stripe on the lens gear that aligns to the stripe on the follow-focus gear, has been mis-set. A lens gear that has no "witness mark" should be set with its infinity mark matched to the lens-mount scribe. If the follow-focus gear does not mesh easily with the lens gear, the lens should be set with the infinity mark one tooth *beyond* the mount scribe (i.e., past infinity) to mesh the gears.

Very slight variations in parallax can be corrected if the Operator turns the parallax-adjustment screw located below the viewfinder. Even if "right on," the procedure is repeated at 10-ft and 5-ft intervals.

If all the measurements vary, then it is more important that the parallax-adjustment screw below the offset viewfinder be adjusted for the closest measurement (i.e., 5 ft). Then the Operator sets the focusing-tube cross hair on a subject at 10 ft and 15 ft. He checks the position of the viewfinder cross hair at those respective measurements so he will know on which side of the viewfinder cross hair the subject will be centered on the film at those distances. (See Sec. 7.2c.)

6.1g "Flare check"

A *"flare check"* determines if any spill from backlights or kicker-lights is shining into the lens. "Flare" is eliminated by either readjusting the barn door on the offending light or placing a "flag" on a stand between the camera and offending light.

6.2 DURING SHOOTING

With film-scratch test, "hair check," "flare check," and parallax check completed, the First Cameraman is informed in a loud and clear voice, "Camera ready!" This serves notice to everyone in the crew as well that shooting is close to commencement. (Some production companies have a bell rigged to the camera as a "camera ready" signal.)

Once the rehearsal or scene is ready to be filmed, the Assistant always remembers the word "F-A-S-T." Not only as a way to conduct himself, but as a check on:

F—focus (distance of camera to subject)
A—aperture (*f*/stop or T stop setting)
S—shutter (degree of opening)
T—tachometer (speed of camera)

6.2a Focus measurements

Focus measurements are always taken as unobtrusively as possible, without interfering with the Director and/or Actors.

Marking-tape strips. Lengths of black tape approximately 4 in. long, which have been torn off the roll when setting up earlier and applied to the camera magazine or housing until needed, are used to mark the position of the Actors and are placed on the studio floor in an "X" or "V." Then, even if the subject leaves his mark, there is a reference for measurement.

Follow-focus marks. If there are numerous subject and/or camera moves in one take, many Assistants place a strip of white camera tape close to the follow-focus knob and mark it with position numbers and actual focus distances (e.g., 1–10 ft, 2–15 ft, 3–9 ft); then, setting the lens at the actual focus distances, mark the follow-focus dial with only the position numbers (e.g., 1, 2, 3). The camera tape is used for reference in the event the count is forgotten while filming. A quick check of the footage mark on the lens against the focus distance marked on the tape gives the position. Also, if the camera is dollied out of sequence, a quick check of position against focus or vice versa will provide orientation.

The Dolly Grip invariably marks his position on the floor at the back end of the camera in chalk or with tape, and the smart Assistant Cameraman will mark the same position number on the floor in front of the camera, whenever possible, for quick reference as to his whereabouts in the sequence.

Estimating focus. Another habit every Cameraman develops is estimating the distance from camera to subject *before* checking it against the actual tape measurement. Constant practice then prepares him to

make a quick focus adjustment with reasonable accuracy while filming, should the subject or camera (or both) miss the preset marks. On interiors, it is also helpful to predetermine the depth and width of the set, and then measure the 1/4, 1/2, and 3/4 distances, using important props or set dressings as reference marks. In due time the Assistant will reach the point where he will need only one measurement per setup, and thereafter, no matter where the subject or camera moves, will adjust focus accordingly, being less than 6 in. off true distance. But it takes considerable time and practice to achieve a proficiency of that caliber.

Other problems. On a dolly shot involving long lenses, the Assistant will mark the floor every 12 in. and mark each corresponding foot on the follow-focus knob. As the dolly's front runningboard reaches each floor mark, the focus is conformed to that mark.

When a subject moves toward the camera and it is impossible to mark the floor, set dressings are used as reference points and their distances marked accordingly on the follow-focus knob; or, as noted elsewhere, if possible a measuring tape is hooked into the subject's belt and reeled in or out by a Second Assistant, who calls off the footage for the First Assistant who is "pulling focus."

6.2b Lens-aperture stops

The general practice of the Assistant Cameraman is to ask the First Cameraman if his readings will be in *f*/stops or T stops. Thereafter the lens stops are set to conform to this preference.

When given a stop, the Assistant *always* repeats the reading aloud to verify his understanding of it. The First Cameraman (who has many things on his mind at one time) is reminded of the statement he has just made, and it also provides him the opportunity to affirm or correct his reading.

First Cameramen usually try to maintain a constant foot-candle measurement (especially on interiors) so that exposure and density remain constant throughout the film. In the event the First Cameraman should forget to mention the stop, the Assistant can be fairly (but not always) safe if he sets the diaphragm at the last reading given or asks the First Cameraman if the reading is the same as the last one.

In the event the Assistant forgets to stop down, is not sure he has, or has set the wrong stop, it is his responsibility to mention the error to the First Cameraman. The Assistant does not fear the consequences of his failure (there isn't a man alive who hasn't made a mistake, or been the victim of one). The First may not appreciate the loss of the shot, but his professionalism will make him recognize the integrity of the Assistant in admitting the mistake. Unless he's a prima donna, the First will quietly order a retake, giving the reason to the powers that be that, as First Cameraman, he did not approve of the shot (his prerogative). When the day's work is over, however, it is also his prerogative to take the Assistant aside (far from the cast, crew, and

clients), thank the Assistant for the integrity brought to the job, and *then* voice his opinion of the loss of the shot, in whatever manner he chooses. And the professional Assistant admits his mistake, offers no excuses, and endeavors not to repeat the error.

Then they both forget it and start fresh the next day.

6.2c Shutter

On cameras equipped with *variable shutters*, whenever a shutter is changed from its normal opening the *Operator* sets the shutter and the Assistant makes *two* "reminder tapes." One (marked "SHUTTER") is prominently taped to the Assistant's side of the camera. The other is taped to the shutter handle and extended down the back of the camera to cover the footage counter, so that the Operator is forced to lift the tape in order to give the footage count to the Assistant. This procedure in itself will remind the Operator that the shutter is set less than normal and that he should check the degrees of opening each time he lifts the tape.

Thereafter, at each reading the Assistant reminds the First Cameraman that the stop is being set at a specific aperture and degree of opening, so that the First Cameraman can be certain to compensate for it (e.g., "2.8 at 135°").

Once the shutter is returned to normal, both reminder tapes are discarded. The shutter handle is reset by the Operator and double-checked by the Assistant to verify the shutter is open and locked in position.

6.2d Tachometer

Synchronous and constant-speed motors require no checking, provided the voltage necessary to run the motor is known to be constant. The voltage to the camera is checked periodically by the electricians. Any dimming or brightening of lights on the set, or variation of motor noise while filming, is of course an indication of a change in motor speed (and therefore a difference in exposure). Cameras not equipped with a tachometer need close checking; it is common practice, where voltage variation is suspected, to wire a voltmeter (which acts as a "tachometer") into the line that is feeding "juice" to the camera. This is especially helpful when filming in a strange location and using an AC line from an unknown power source.

Low voltage applied to a synchronous or constant-speed motor will run the camera slower than normal; when suspect voltage can be checked by observing the camera pulldown claw with a strobe light. Most often, however, it is discovered by "hearing" the slow motor speed.

Too high a voltage will either blow a fuse of cameras so equipped, heat an unfused synchronous motor, or heat a constant-speed motor abnormally and eventually burn it out.

Variable-speed motors require a tachometer. While the camera speed is set by the Operator, whose responsibility it is to make certain the

speed is constant when the camera rolls, the Assistant always leans around the Operator to verify it.

6.2e Filters

Whenever a filter is inserted in the camera or lens, a "reminder tape" marked "FILTER IN" is prominently placed on the camera or lens to avoid the possibility, for instance, of moving from an exterior location to an interior with a filter in place. (Even those with the best of memories can overlook this simple item in the haste of breaking down and setting up again.) This especially applies to zoom lenses with rear-mount filter holders. Also, by marking the *type* of filter in place, mistakes in exposure can be avoided.

When sliding a gelatine filter holder into a camera fitted with a filter slot, *it is imperative* that the Assistant open the camera door (or remove a lens) and verify that the holder is seated (i.e., clears the aperture) and that pressure has not pushed the filter out of place in the holder (which would result in a partially filtered frame). The filter will slide in its holder if the gelatine has not been cut evenly to conform to the perimeter of the holder or if it has not been seated deep enough in the holder. To avoid sliding, of course, it should be taped in place *inside* the holder before insertion in the slot.

Filters are more sensitive than lenses to fingerprints, dust, scratches, etc., therefore the Assistant exercises greater care when handling them. Care against filter "burn" is perhaps most important to guard against, although it is the least considered (and least known) precaution taken. "Burn" is caused by the delicate gelatine being rubbed as it is inserted into the filter slot. An almost imperceptible difference in the thickness of the gelatine results, which, depending on the lighting of a scene, may show up on the projected film as a diffused spot or streak, a lighter area within the frame, an opaque area, or halation. Many scenes have been reshot, lenses unnecessarily bench-checked, or cameras retired because of an unexplainable "smudge" on the negative. A careful check—at the time of insertion—of the filter holder would have avoided all the trouble.

A glass filter (which is usually a sheet of gelatine sandwiched between two pieces of optical flat glass) may not "burn," but wide scratches or abrasions on the optical flat have a similar effect.

Quite often a gelatine neutral-density filter will be used to partially filter sky or brightly lit areas. Most Assistant Cameramen include a sheet of optical flat glass in their kit which they insert into the matte box. Then, sighting through the camera focusing tube, they trace on the flat—with a grease pencil—the area to be filtered. It calls for considerable manual dexterity, as often the Assistant must sketch backward and left-handed, and orientation is difficult. Once traced, the optical flat is removed, the gelatine filter placed on the flat *opposite* the grease marks and cut to conform to the grease pencil mark. It is then taped to the flat and reinserted into the matte box to check whether the filter is properly cut and placed. If "trimming" is unneces-

sary, the grease pencil marks are removed with carbon tetrachloride, the flat reinserted, and alignment rechecked before shooting.

WARNING: It is imperative that the filter be aligned with the lens stopped down to the aperture at which the scene will be photographed (never wide open). Even a slight variation of light values from one "take" to the next is sufficient cause for realignment of the filter in the matte box.

6.2f Film jams

Film jams, i.e., pile-ups of film inside the camera movement area, are an accepted (albeit not too graciously) fact of life in film work. They halt production and must be cleared quickly and, most important, efficiently.

One of the commonest causes of camera jams is improper loading of the magazine feed side. Many feed spindles are fitted with ball-type or spring-action–type spindle keys that retract into the spindle post whenever a core is slid over the feed spindle. It is imperative when loading the magazine to rotate the raw-stock core until the spindle key engages the core slot. Otherwise, when the magazine is mounted on the camera, the raw-stock (feed) core rotates at a slightly slower speed than the feed spindle until inevitably the ball-type or spring-action–type key on the spindle pops up into the core slot. At that moment an almost imperceptible halt in the rotation of the raw-stock core occurs. However infinitesimal the interruption of the film flow into the camera, it is enough to put the film perforation out of alignment with the pulldown claw and cause a jam.

Other causes of film jams are improper size of loops; registration pins or sprockets not properly engaging film perforations (misthreading); belt slipping (too loose or greasy); improper take-up winding; and no take-up on the magazine. Consistent jamming caused by some emulsion surfaces "sticking" in the gate (usually a characteristic of emulsions with high ASA ratings) can be eliminated in an emergency by applying a noncorrosive silicon spray to the gate or plate. (Usually, the "cure" is to send the camera or magazine to the factory to have the plate relieved a few thousandths of an inch or have the solid piece pressure plate segmented, i.e., divided into three parts.

When removing jammed film, the Assistant should exercise extreme care so that the internal workings—especially registration pins, pull-down claws, sprockets, and plate—are not bent or scratched.

Jammed camera film is always broken at the magazine feed and take-up rollers and removed from the camera interior *by hand*—never with pliers or screwdrivers. When film has doubled back, or is so lodged in the mechanism that sprocket-guide rollers or plate cannot be cleared easily, all excess film must first be removed and the remaining lodged film gently pulled *by hand* back and forth along the axis of the normal film flow to clear it. If needlenose pliers *must* be applied to remove the film, most Cameramen give serious consideration to retiring the camera, as it is almost certain that some part of the mechanism will be sprung out of alignment.

NOTE: It is the practice of some Cameramen to clear a small jam and roll the excess film into the take-up side and continue shooting without taking into consideration that the tensile strength of film stock is weakened when pleated, and torn sprockets or nicked raw stock may pull apart when the film is *pulled* through the developing machine. (A 2-minute experience in a laboratory in the midst of clanging bells and frantic Technicians shoving people aside in an attempt to save film that has broken somewhere in the line will acquaint one with the location of the original panic button—it stops the developing machine!)

Once clear of jammed film, the camera must be blown out completely—especially checking the aperture for film chips—and reoiled before threading. Once rethreaded, the sound of the mechanism, visual movement of raw stock as it travels from feed to take-up side, and the tachometer, for variation of speed, require careful checking. After a short burst of film and the first "take," inspection of the aperture *again* is mandatory to insure that film chips—which might have lodged in the shutter mechanism at the time of the jam—have not been thrown into the aperture area.

Then filming resumes.

6.3 END OF SHOOTING DAY

At the end of the shooting day, the Assistant Cameraman makes a final "hair check," runs off an additional amount of footage (usually 5 ft in 16 mm, 10 ft in 35mm) into the take-up to assure the last take will not be fogged when unthreaded or stapled to the laboratory leader when being developed.

He then checks with the First Cameraman and Operator to learn if there is any special camera accessory desired for the next day. If so, he orders it from the Camera Department or Assistant Director. He verifies his camera reports (prints and holds) with the Sound Mixer and Script Supervisor. Then he unthreads and disassembles the camera, and packs it away in its proper cases.

In the darkroom, he unloads the magazines and cans, and prepares the exposed stock for shipment (in many cases takes it) to the laboratory. He reloads magazines for the next day's shooting, if necessary.

A fresh inventory of raw stock is taken, (including what is in the freshly loaded magazines), and this report is submitted to the Assistant Director.

All camera cases are returned to the camera department and/or stored in the camera room.

Invariably he is the last man to leave the job, and as he crosses the darkened stage, he knows he can look forward to being the first man there in the morning—and starting the procedure all over again.

6.4 TOOLS

The tools an Assistant Cameraman uses are worth mentioning here. The Assistant carries his tools in a "ditty bag"—a canvas pouch (with pockets of various widths sewn to the sides to accommodate tools and

accessories) which is affixed to a tri-webbed bridle ending in a snap hook. The bag is hung below the tripod or camera dolly.

The tools an Assistant Cameraman carries in his ditty bag vary, based upon personal preference, but the basic kit generally consists of the following:

50-ft cloth measuring tape
lens brush
magazine brush
flashlight
scissors
tweezers
rubber-bulb syringe
two orangewood sticks
magazine brake
set of jewelers screwdrivers
set of hex wrenches, 1/32–3/16 in.
6-in. combination pliers.
6-in. needlenose pliers
4-in diagonal cutters
6-in. crescent wrench
1/4-in., 3/16-in., 1/8-in. blade width screwdrivers
No. 1, No. 2 Phillips-head screwdrivers
one sheet of crocus cloth (ferric-oxide–coated)
black cloth, 6 x 18 in.
white grease pencil
chalk
felt marking pen
pencils
lens tissue
camera oil

The 50-ft cloth tape is used for measuring the distance from subject to film plane.

The lens brush, of soft sable or camel's-hair, is always capped to keep it dirt- and grease-free.

An inexpensive 2-in.-wide brush, with bristles cut to a length of 1-1/2 in. (to give it stiffness) is excellent for cleaning magazine interiors and rollers.

The flashlight permits viewing the aperture, lens settings, etc., on a darkened sound stage.

Scissors are for cutting gelatine filters, tape, etc.

Tweezers are for handling cut filters, small screws, and small pieces of masking tape.

A rubber-bulb syringe provides sufficient air pressure to blow lint from the aperture, chips from the camera interior, and dust from filters and lenses.

Orangewood sticks, one large and one small, are the only instruments to use in the removal of emulsion build-up in the camera aperture or plate.

The magazine brake prevents the film from unraveling on the feed side of the magazine (see "Magazine Brake," under Sec. 7.7c for construction of a magazine brake).

The various screwdrivers, pliers, and hex wrenches are necessary for camera assembly, teardown, and emergency camera repairs.

Crocus cloth is used for cleaning motor contacts, removing rust, etc.

The black cloth can be draped over the space between the matte box and camera whenever there is the possibility of stray light striking the rear of the glass matte-box filter and "kicking back" into the lens,

or if there exists the possibility of a sidelight directing a beam between matte box and camera and striking the face of the lens.

The white grease pencil is utilized to mark focus and focal-length positions directly on a zoom-lens barrel. The grease wipes away easily.

The chalk, felt marking pen, and pencils are for writing on the slate, camera tape, and follow-focus discs, respectively.

Lens tissue is the only item to use when cleaning a lens besides a good lens brush.

Camera oil—**not** machine oil—should be used on the camera's interior movement.

There are many items not on the list that Assistant Cameramen consider indispensable; however, with the exception of those mentioned above, no two Cameramen can agree on what they are, for everyone, it seems, has a favorite tool or item that "everybody should have in his kit!"

CHAPTER 7

Introduction to Equipment

A piece of equipment responds in its performance in direct proportion to the amount of thoughtful care and study it is given, and a motion-picture camera is no exception. Technically, a camera is a machine—a mechanical device. However, this is only part of the story: a camera is also a delicate creative tool which requires special attention and handling if it is to perform up to its maximum potential.

There are two types of "production" cameras: those equipped with a reflex viewing system and those equipped with an offset-viewfinder system.

7.1 THE REFLEX VIEWING SYSTEM

Cameras equipped with reflex viewing systems utilize prisms and mirrors between the "taking" lens and the viewing eyepiece so that a scene may be directly viewed through the taking lens during shooting.

No rackover or parallax correction is necessary, as in the offset-viewfinder system.

The eyepiece of most reflex systems views exactly the same area as the camera aperture. However, some systems permit the Operator to view a limited area *outside* the aperture field. The camera-aperture area is scribed on the groundglass and the Operator must keep his composition within the scribed limits so that he will photograph only the desired area.

Any focus change is immediately apparent, and the Operator can correct focus himself, if necessary, provided his "pulling focus" coincides with the movement of the subject toward or away from him and he is thoroughly familiar with the direction the focus ring rotates in order to "follow focus."

A disadvantage of the reflex system is that the more the lens aperture is "stopped down," and the more filters that are added to the matte box or lens, the less light is transmitted to the eyepiece. Heavy filtering in conjunction with small lens openings can make viewing difficult, as compared to the unobscured viewing through an offset viewfinder.

Some reflex cameras *do* have a filter slot behind the mirrored shutter which eliminates the front-filter problem. On these cameras, the taking lens is stopped down less than normal because filter positioning reduces light only to the film, and not to the eye. However, many Cameramen are reluctant to place a gelatine into a filter slot because of its proximity to the focal plane. Any dirt or dust on the gelatine will register conspicuously on the negative when the lens is stopped down to an aperture that brings the debris into focus on the film.

7.2 THE OFFSET-VIEWFINDER SYSTEM

7.2a Rackover

Cameras equipped with an offset-viewfinder system utilize a monitoring viewfinder attached to the side of the camera *and* a focusing tube. Direct viewing of a scene through the taking lens cannot be achieved *during shooting*. However, direct viewing of the scene through the taking lens can be achieved *before and after* each take by aligning the focusing tube with the taking lens. This alignment process is called *rackover*.

On the majority of cameras covered in this volume, rackover is accomplished by the Operator rotating a handle and shifting the camera body laterally. On other cameras, rackover is accomplished by the Operator rotating a handle which causes a prism to be inserted between the taking lens and a focusing-tube eyepiece—the camera body is not moved.

Rackover is necessary so that the Operator can check focus, composition, and make corrections for parallax. Looking through the focusing tube, the Operator sees the scene as the camera will "see" it.

In any case, the camera aperture has been displaced, and the Operator must remember to "rack back" before filming begins, otherwise images will not be recorded.

7.2b Conforming viewfinder to taking lens

The field of the offset monitoring viewfinder must conform to the field of the taking lens as seen through the focusing tube; this is accomplished by two methods:

1. When the viewfinder is equipped with a focal-length scale and adjustable ribbon mattes (within the viewfinder itself), the mattes are moved horizontally and/or vertically to the focal reference marked on the scale; 2. When a viewfinder is *not* equipped with adjustable mattes, a plastic matte is inserted into a slot in the viewfinder itself.

7.2c Correcting for parallax

With viewfinder field conformed to the taking-lens field, the Cameraman must then consider parallax.

For a Cameraman, a practical definition of *parallax* is: the difference between the viewpoints of the offset viewfinder and the taking lens.

Manufacturers position the taking lens on the turret of offset-viewfinder cameras as close as possible to the viewfinder in order to minimize parallax. However, it cannot be entirely eliminated and must be compensated for.

(A simple example of parallax is seen by fixing on an object and alternately closing and opening each eye. The apparent "jump" of the object results from the lateral difference between the "lens" of one eye and the "viewfinder" of the other. With both eyes open, the lines of sight are parallax-corrected because the lines of sight of the eyes intersect—i.e., converge—at a specific distance because of the automatic accommodation built into normal human vision.)

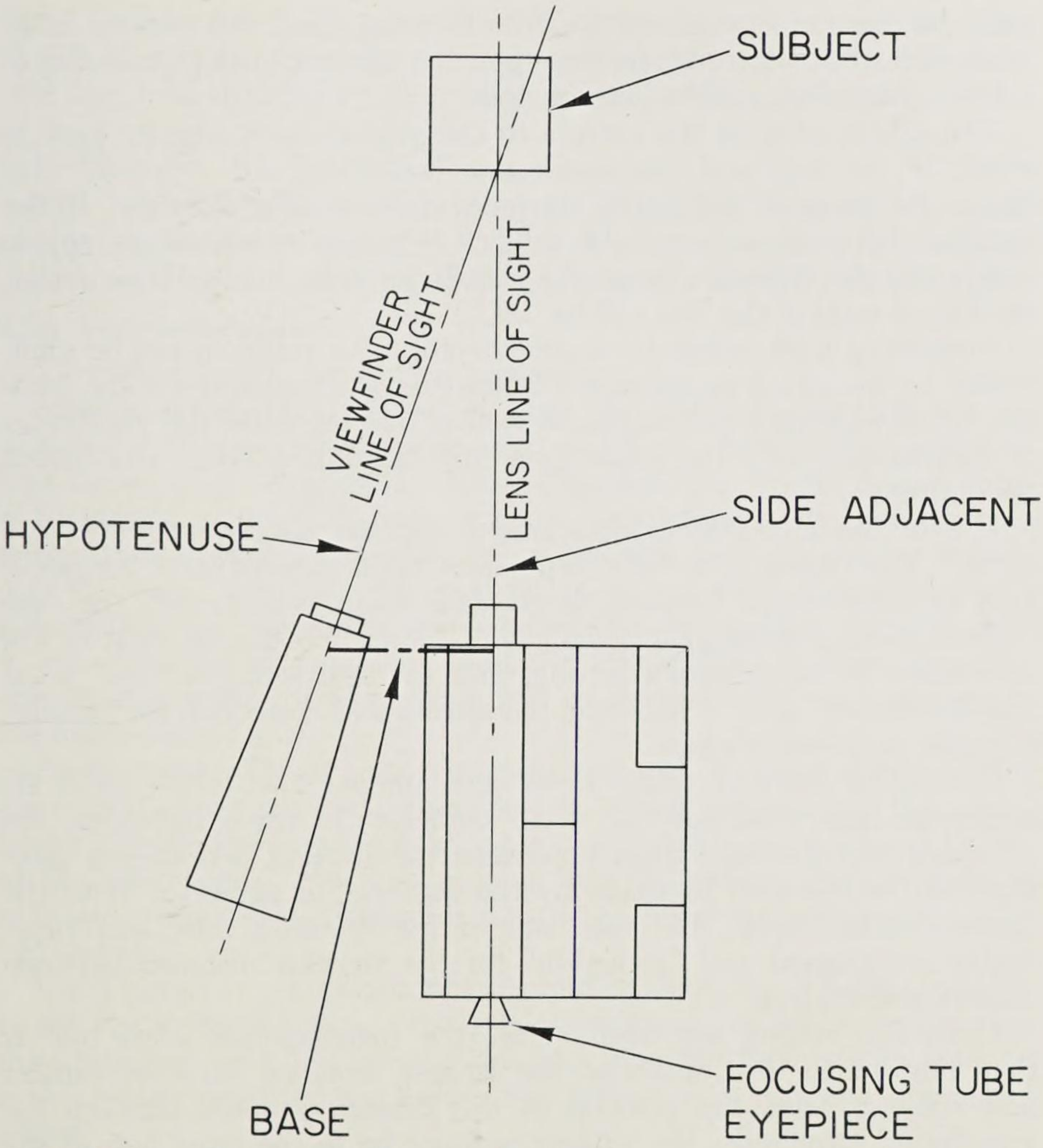


Fig. 7-1. Parallax triangulation diagram.

Parallax is compensated for by conforming both the *viewfinder cross hair* and the *focusing-tube cross hair* to the subject so that at a specific distance the lines of sight of both viewfinder and taking lens intersect. In other words, by matching the cross hairs a simple mathematical triangulation is achieved (see Fig. 7-1). If (1) the lateral difference between the taking lens and the viewfinder is considered the base of a right triangle, and (2) the line of sight of the lens is considered the adjacent side of the triangle, then (3) the line of sight of the viewfinder forms the hypotenuse of the triangle.

To accomplish the intersection of lines of sight, the viewfinder must be pivoted (or its optics shifted) laterally. At infinity, the rear of the viewfinder is almost parallel to the camera body because the subject is far away and parallax is at a minimum. However, at an 18-in. distance from camera to subject, the rear of the viewfinder

must be pivoted (or its optics shifted) away from the camera body as much as 6–12 in. (depending upon the camera model) in order to achieve intersection of the lines of sight.

The relationship of the camera to the subject must also be kept in mind. If the lens and viewfinder are "locked-in" for a specific distance, the lines of sight will converge only at that distance. If the distance between camera and subject increases or decreases appreciably and the Operator keeps the viewfinder cross hair on the subject, the line of sight of the lens will be "off."

Correcting with follow-focus attachment. This problem can be eliminated by mounting an accessory follow-focus attachment on the camera, which utilizes a gear-and-cam system that regulates the viewfinder in conjunction with the focus (see Mitchell follow-focus attachment for example).

Use of the follow-focus attachment requires an Assistant to "pull focus." The Operator is fully dependent upon the Assistant for accuracy of composition because, if the lens focus is incorrect, the cam (which rides a worm-gear roller) will change the line of sight of the viewfinder to an incorrect setting, and the lens will not "see" what the viewfinder "sees." Therefore, the setting and correction for parallax is a vital cooperative effort.

Correcting without follow-focus attachment. The follow-focus attachment cannot be used on some cameras. In these instances, the Operator and Assistant must determine the starting and ending positions of the move to be made by the camera (or subject). With the camera racked over, the cross hair of the focusing tube and viewfinder are aligned and "locked-in" for the shortest distance between camera and subject.

Once this setting has been made, the focusing-tube cross hair is then aligned to the subject at the longest distance between camera and subject. Then the position of the subject is noted through the viewfinder. Obviously, the subject will not be in the cross hair of the viewfinder but to one side of it. If the Operator remembers that, at that particular distance he must position the subject at that particular place in the viewfinder, then the lens will "see" the subject correctly. As the distance shortens, the Operator gradually centers the subject, so that upon reaching the shortest distance, the cross hairs of the viewfinder and the lens are correctly aligned.

7.2d Racking back

Before filming starts, the racked-over camera must be racked back so as to place the camera aperture and film in alignment with the taking lens. Some cameras which are not fitted with an automatic cutout switch will run in the rackover position, and there are many Operators on record who have executed the best camera movements and compositions of their careers on blank film. Most Operators develop the habit of sighting through the viewing tube and "wiping out" the scene as they rack the camera back into shooting position so as

to be certain they have actually aligned the taking lens and the film. It also affords the Operator a last-minute comparison of the lens field with the field outlined by the ribbon mattes in the viewfinder.

7.3 MATTES

The basic definition of a matte, as applied to cameras, is worth mention here. A true matte is a sheet or plate inserted into a camera and/or viewfinder to obscure a selected area of a scene by shortening it.

7.3a Viewfinder mattes

Viewfinder mattes are ribbon or plastic:

Ribbon matte. This is a set of very thin metal bands that can be adjusted within a viewfinder so as to match the field of the particular lens in use (the taking lens). When adjusted, the ribbon mattes form a tic-tac-toe crosshatch thus: ⧦ . The rectangular field formed within the crosshatch is known as the aperture field, because it delineates the area "seen" by the actual camera aperture. The rest of the area within the viewfinder surrounding the rectangular aperture field is not obscured in any way. However, the Operator must keep his composition within the aperture field or the lens will not photograph the desired areas.

Plastic matte. This is a semiopaque sheet with a precut aperture field appropriate for a particular focal length. When inserted into the viewfinder it limits the viewing field to that appropriate for the focal length of the taking lens. The area surrounding the cutout aperture field is semiobscured, and the Operator must keep his composition within the cutout field.

Unobscured or semiobscured surrounding fields permit the Operator to see microphone booms, off-screen movements, or other objects that may interfere with his composition and give him warning in time to make proper adjustments before the taking lens sees the unwanted object.

Hard mattes are opaque and made of thin metal. These include the following types:

Aperture matte. This is a shim which is inserted into the aperture plate within the camera body to make certain that a portion of the film is not exposed when shooting. Most common is the Academy Matte, which covers what is ordinarily the area reserved on a print for the soundtrack.

Focusing-tube matte. This is a shim inserted into the focusing tube, forward of the groundglass. This matte is necessary whenever an aperture matte is inserted into the aperture so that the focusing-tube field of composition conforms to the aperture field.

NOTE: Frequently (especially when filming TV commercials), a matte is inserted into the focusing tube only, and not the aperture plate. This permits exposure of the full aperture. Later, the framing of the scene can be adjusted or reduced in the optical printer to achieve a better composition for the titles, product, etc.

7.3b Effects mattes

An *effects matte* is a special-purpose cutout of metal, gauze, or film, and may be inserted into either the aperture, focusing tube, or the matte box—a holder in front of a lens that accepts filters, opaque or cutout mattes, gauzes, etc.

Most common of all effects mattes in studio production is the film-frame matte, used whenever match dissolves are desired. A frame of processed film (either negative or print) is punched out on a special matte cutter (to ensure perfect registration) and inserted into the focusing tube for alignment with another object.

Other special-purpose effects mattes, such as keyhole, binocular, and gunsight, are opaque shims or gauze inserted into the aperture-plate slot or matte box. However, these effects are more often left up to the optical department of a special-effects house. The time and cost necessary for the shooting of these aperture effects on a sound stage, with a full crew in attendance, often far exceeds the expense of having it done in an effects house.

7.3c Camera mattes

A *camera matte* is an adjustable blade built into the camera body which enables the Cameraman to split any portion (horizontal, vertical, or both) of the aperture he selects. Again, while this convenience is available to the Cameraman, most effects of this nature are turned over to a special-effects department because of the time and cost involved.

> NOTE: An erroneous use of the terms "TV mattes," "ratio mattes," etc., is often applied to the area scribed on the camera groundglass. This scribe indicates the Operator's "safe-action area," or "composition aspect ratio"; and he must keep his action within this area because of the limitations of the screen imposed by TV-receiver "cutoff" or the intended release form of a film for theaters. The distinction should be clearly understood and proper nomenclature used.

7.4 CAMERA MOTORS

Early cameras were hand-cranked, and some modern cameras, although motor driven, still incorporate the hand-cranking capability. When motors were first introduced to the industry, the sound stages reverberated with the alarming cry of, "What are they trying to do, eliminate the Cameraman?" (Early Cameramen weren't called "cranks" without reason.) Today the skill required to hand-crank a camera at the proper speed is a lost art, and for the most part academic.

The nearest a modern-day Cameraman gets to hand cranking is when the shutter obscures his viewing optics. Most motors are equipped with a knob which, when turned manually, moves the intermittent—i.e., pulldown claw, sprocket, shutter, and registration pins, (often referred to as "the movement")—and clears the shutter from the viewing optics. On most offset-viewfinder cameras this knob is called a "manual–motor-turning knob," while on most reflex cameras it is called an "inching

knob." Some cameras have a knob or plunger built into the camera body to clear the shutter from the viewing optics.

Motors built for cameras fall into seven general categories:

7.4a (1) Variable-speed motors

Often called "wild" motors, these are rheostat-controlled so that the frame-per-second rate can be adjusted. They are most often used when filming "silent," or when variation of speeds (within certain limitations) is required to speed up or slow down action.

7.4b (2) Constant-speed motors

Constant-speed motors are governor controlled to operate the shutter at a constant 24 frames per second. Powered by direct current, they are most often used when filming "silent" and no variation of speed is desired, or when filming sound in conjunction with a "sync-pulse" recorder. To achieve synchronization, the camera or motor must be fitted with an added AC sync-signal generator to provide a frequency signal to the recorder so that any variation in the motor speed (fast or slow) will electronically compensate the speed of the recorder to match it.

7.4c (3) Synchronous (sync) motors

Sync motors have a definite speed strictly proportional to the frequency of the operating current (60 Hz in the U.S., 50 Hz in Europe).

> NOTE: The international unit of frequency measurement is the hertz (Hz), which is equal to 1 cycle per second. The old familiar term "cycle" is slowly being phased out (no pun intended) in favor of the adoption of the international term hertz.

Sync motors are most frequently used when filming sync sound (dialogue, etc.) in studios or areas where AC is available, in conjunction with sound recorders. To achieve synchronization the camera motor and recorder must be connected to the *same AC power source* so that any variation in the frequency of the source will be transmitted to both units. In many studios, the Sound Department will "run camera," i.e., the camera line will be connected to the recorder, and the camera will not run until the recorder is turned on. The recorder in turn is connected to one AC source which supplies power and the same frequency to both units.

7.4d (4) Animation (stop-motion) motors

The stop-motion motor registers a single frame each time the motor switch is activated. They are most frequently used to give "movement" to artwork or inanimate objects.

7.4e (5) Interlock (selsyn, i.e., self-synchronous) motors

In a selsyn system, two motors are electrically phase-connected so that one (the "drive") provides the same rate of power, speed, and rotor position to another (the "slave") so that the camera intermittent and a projector intermittent are in "sync." They are most frequently

used when filming "process shots" (rear projection) so that the camera photographing the live action in the foreground is synchronized with the rear-projected background.

7.4f (6) Time-lapse motors

The time-lapse motor is activated at long intervals by a preset timing device to expose one frame at a time so that when the film is projected the subject moves rapidly. While the time-lapse motor is similar to an animation motor, the timing device places the time-lapse motor in a separate classification. It is most frequently used in nature studies (such as when recording the blooming or growth of a flower) and in industrial research.

7.4g (7) High-speed (slow-motion) motors

High-speed motors are operated at accelerated speed, the slow-motion motor causes the camera to expose a greater-than-normal number of frames so that when the film is projected at standard speed the subject moves slowly. They are most frequently used for a "time-extension effect," or for scientific study.

It should be noted that while most manufacturers classify a motor as "high-speed," and while many Cameramen refer to it as such, to be technically correct it is often a slow-motion motor.

Motion-picture engineers agree that the frame-per-second (fps) speed of a motor determines its classification. For example:

Animation—1 frame per motor-switch activation
Time-lapse motor—below 10 fps
Intermittent motor—10 to 30 fps (variable or sync)
Slow-motion motor—30 to 300 fps
High-speed motor—300 to 10,000 fps
Very-high-speed motor—10,000 to 300,000 fps
Ultra-high-speed motor—300,000-plus fps

Therefore a camera motor must conform to the frame-per-second rate of the type photography desired.

The action of the motor and intermittent of a "nonself-blimped" camera creates noise; this noise is controlled by the use of either a Barney or a blimp.

7.5 BARNEYS

A Barney is a sound muffler for a camera and is used to minimize camera noise when absolute quiet is not essential, such as an outdoor location where the ambient noise level is equivalent to or slightly higher than the camera noise.

There are three types of Barneys:

1. A sound Barney is usually constructed of layers of insulating materials encased in a canvas or plastic cover, and lined with non-abrasive wool–nylon fabric. 2. A heater Barney is of similar construction to the sound Barney, but is wired electrically and serves to keep

the camera warm in cold weather. A heater Barney is invariably covered with a reflective material so that the unit can also be used to insulate against the heat of the sun in desert or jungle locations. 3. A magazine Barney fits only the magazine and does not cover the camera. It is intended to muffle the noise of a nonsoundproofed magazine being used on a self-blimped camera (such as a 16mm Mitchell 1200-ft magazine on an Auricon Pro-600 camera).

Sound and heater Barneys are fabricated for use with a particular manufacturer's camera, and therefore will vary in size and shape, with opening and/or viewing ports suited for the camera.

Basically, however, a Barney is open at the bottom so that the unit can be draped over the camera. A front port allows the camera matte box to extend beyond the covering. Various flaps and latches provide access to the camera itself, while openings in the Barney permit various components (viewing systems, follow-focus units, etc.) to extend beyond the confines of the fabric.

Unlike a blimp, a Barney cannot be used as a noise suppressor when shooting on a sound stage.

The term "Barney" originated in the early days of sound filming when heavy horse blankets were used at exterior locations to cover the cameras and minimize the noise. At that time, a popular comic-strip character named "Barney Google" had a never-winning racehorse named "Sparkplug" who wore an old patched blanket. Cameramen would often call for a "Barney Google horse blanket." The term was then shortened to a "Barney Google," and eventually evolved into the present-day term.

7.6 BLIMPS

7.6a Description

A blimp is an acoustical housing designed to eliminate virtually all camera noise. Like a Barney, it varies in size and shape, and has ports peculiar to the camera for which it is built. Unlike a Barney, it has no permanent openings, so that the camera is completely enclosed within it. Access doors permit camera adjustments.

Blimps are constructed of fiberglass, aluminum, magnesium, or a combination of these, and are filled with layers of sound-absorbing materials and lined with velvet, corduroy, or similar fabric.

Blimp interiors are either fitted with a support similar to a tripod head plate or a special adapter for positioning the camera securely within it. A follow-focus unit which, through a gear-and-cam system, permits the focusing of the camera lens from outside the blimp is standard.

NOTE: On a blimp, the gear-and-cam system, which is an integral part of the blimp, is called a follow-focus *unit*, but a detachable accessory which can be mounted on a camera is called a follow-focus *attachment* (see Sec. 7.2c "Correcting with a Follow-Focus Attachment").

On some models a similar gear-and-cam arrangement also controls lens-aperture setting. All have "spring-action" knobs or levers which must be depressed in order to engage camera components to change their positions.

A sunshade, either fixed or variable (bellows), mounts at the front of the lens-access door. The front optical flat must be constantly checked for cleanliness because any dirt, dust, or streaks on the glass will be readily photographed.

7.6b Insertion of camera

Use of a blimp requires that most, but not all, cameras be adapted to the blimp, either by changing the eyepiece, motor, door, or fitting of lenses with gears.

Insertion of the camera into the blimp and alignment of gears, fittings, couplings, etc., must be conducted with extreme care. If any part of the unit binds, or doesn't fit easily, it is best to remove the camera from the blimp and reset the couplings, gears, fittings, etc., in their "throw out" position, i.e., where they will not interfere with the camera components they serve.

The smoothness of the blimp follow-focus unit is important. A "stiff" unit can frequently be freed by checking the pressure knob which creates "drag" for smoothness of operation. Stiffness may also be caused by the lens-ring gear (which meshes with the follow-focus gear) being improperly mounted on the lens. If canted, the lens gear will bind and interfere with the smoothness of a focus change. The lens-gear coupling should also be checked for a too-tight fit with the follow-focus.

7.6c Light kickback

Most blimps are equipped with ports and internal "work" lights to provide easy viewing of the camera components. The internal lights must be extinguished prior to "rolling" film to avoid possible internal light rays "kicking back" into the lens and ruining the scene. Any external light, such as sunlight or a sound stage luminaire shining into a port can also cause "kickback." The problem is easily cured by cutting "flaps" out of thin cardboard or film cartons and taping them, at the top only, over a port.

7.6d Noise problems

Noise from a blimp can usually be traced to a poor fit of a blimp–camera component. Lens and follow-focus gears that are too tightly meshed will transmit camera noise through the shaft of the follow-focus handle. Conversely, if the gears are too loose, vibration "chatter" will be transmitted. Properly meshed gears have an infinitesimal air space between them.

On reflex cameras, the blimp eyepiece is separate from the camera-door viewing system. A light-trap sleeve—a short tubular unit attached to the blimp eyepiece extension—slides over the prismatic assembly of the camera door. If this sleeve touches the assembly, noise will

transmit through the eyepiece. Most Cameramen keep the eyepiece approximately 1/8th in. away from the assembly to avoid any contact with it.

Sometimes an access-door gasket will be damaged, or the door will not seat properly, and camera noise will emanate from it. By walking around the blimp while the camera is running, it is often easy to discover the location of the noise leak. A piece of masking tape placed across the area of the leak will usually silence it.

Then too, the vibration of the camera inside the blimp will often set a component on the tripod head vibrating "in sympathy." Such components should be looked for and tightened or taped.

> WARNING: Perhaps the most important thing to remember about a blimp is the magazine-access hood. Although many are "balanced" to remain open when changing a magazine or checking a scene through a viewing tube, with use the balance weakens. The danger of the hood dropping suddenly and breaking a finger or inflicting a scalp wound is very real. Many Cameramen insert a wooden wedge between the blimp housing and hood at the hinges to prevent such an occurrence.

While blimps are cumbersome and impede production schedules because of the added components and access doors, they are a far cry from the early days of sound shooting when small glass-walled camera huts were built to enclose the camera and crew, so as to avoid picking up the camera noise. These "ice-boxes," as they were called (because the ambient heat from the luminaires warmed the stage but never the interior of the hut), were not only soundproof, but to a great extent "airproof." Directors who believed in long takes became favorite targets for disrespectful opinions expressed with obvious futility by the camera crew members inside the huts. The only benefit the long takes provided was running out of film and a chance to open the doors to let the warm air inside while changing magazines.

7.7 MAGAZINES

A magazine is a lighttight chamber which attaches to the camera and houses film stock before and after exposure at the camera aperture.

7.7a Capacities

35mm magazines accommodate 200-ft, 400-ft, 1000-ft, or 2000-ft darkroom loads; 16mm magazines accommodate 200-ft, 400-ft, 600-ft, or 1200-ft darkroom loads.

7.7b Nomenclature

All magazines, regardless of size or type, contain the following components:

Feed spindle. The interior unit on which the core of the raw-stock roll or the core adapter fits.

Take-up spindle. The interior unit on which the core of the exposed roll or the core adapter fits.

Feed light trap. The lighttight rollers, or passageway, through which the raw stock exits the feed compartment on the way to the camera aperture.

Take-up light trap. The lighttight rollers, or passageway, through which the exposed film enters the take-up compartment after passing the camera aperture.

Magazine throat. That section of the magazine containing both the feed and take-up rollers and which fits into the opening in the camera body.

Lid. The removable part of the magazine, which permits access to the interior. Lids may be threaded, lip- and dog-locked, or key-locked and hinged.

Some, but not all magazines (depending upon manufacturer) also contain the following:

Feed-spindle wheel. The exterior wheel which is attached to the same shaft (through the magazine wall) as the interior feed spindle.

Take-up–spindle wheel. The exterior wheel which is attached to the same shaft (through the magazine wall) as the interior take-up spindle. On some magazines, the take-up spindle wheel accommodates the camera take-up belt.

Spindle-wheel guard. A raised (usually semicircular) piece of metal above the spindle wheel which protects the wheel from contact with the bench (and possible damage) when the magazine is being loaded.

Feed-guide roller. The roller at the end of a metal arm inside the feed compartment. The roller rides the film edge to (a) keep the film edges straight and prevent the film from "dishing," i.e., becoming concave, (the outer edge of the roll being higher, or lower, than the core when laid flat), and/or (b) serve as a footage-counter indicator.

Take-up–guide roller. Same purpose as the feed-guide roller but located in the take-up compartment.

Footage counter. An indicator on the arm of a roller that rides either the feed or take-up film roll so that the amount of unexposed film left in the magazine (subtractive counter) or amount of film exposed (additive counter) may be determined.

Some footage counters work off a sprocket.

Film-tensioner knob. A knob that, when depressed and rotated, engages the core and removes any slack in either the feed or take-up rolls.

7.7c Magazine types

Camera magazines fall into four categories:

(1) The double-compartment type; (2) the displacement type; (3) the coaxial type; (4) single-compartment type.

The double-compartment–type magazine (Auricon, Kodak, Maurer, Mitchell). This type magazine has two separate lighttight chambers in tandem. The left, or front, chamber (feed side) accommodates the raw stock. The raw stock exits the left chamber through a lighttrap, then

re-enters (through a second lighttrap) the right, or back, chamber (take-up side).

The double-compartment–type has the advantage that the take-up side can be checked in daylight when loading the camera, before any exposed film is taken up into the back chamber.

Film is taken up in the Auricon and Mitchell magazines by means of a belt (neoprene or leather) which fits the magazine take-up spindle wheel, and is driven by the camera driveshaft mechanism. The circumference of the exterior spindle wheels is grooved to accommodate the take-up belt. Finger holes or spokes in the wheel diameter are utilized to take up film slack in the magazine by hand.

Some double-compartment–type magazines are provided with adjustable felt pads which brake against the feed-spindle wheel. This serves the purpose of preventing the film from unrolling in the feed compartment when the camera mechanism comes to a stop. (If film does unroll in the feed compartment, it may break when the camera is started up again; the weight of the roll itself is sufficient to snap the film when it is pulled taut.)

Magazine Brake. Since many magazines are not fitted with felt pads, a magazine brake is necessary to provide tension on the spindle wheel. A brake is especially important when filming at high speed.

A *magazine brake* (Fig. 7-2) consists of:

(1) A leather thong, 6-1/2 in. long by 1/8 in. diameter; (2) 3/16-in. by 0.20-gauge spring wire, 2-1/2 in. long. A very small hole is punched about 1/8 in. in from each end of the thong and a piece of wire inserted into each hole to form a hook. Each spring end is then attached to both hooks (forming a circle). The hooks are closed with pliers.

An "emergency brake" is made by knotting both ends of a short length of sash cord, and looping a rubber band around the knots. The brake spring (or rubber band) fits over the wheel guard while the leather thong (or sash cord) rides in the spindle-wheel groove. The slight tension against the spindle wheel prevents the unrolling of raw stock and thereby precludes the possibility of snapping the film when the camera is started again. This portable brake can be removed and placed on a new magazine at every reload.

> NOTE: On magazines that have *no* spindle-wheel guards, a special U-shaped bracket (inside dimension slightly larger than the width of the magazine) with a looped thong (or spring) attached to one arm of the "U" is inverted and slipped over the feed side of the magazine. The thong (or spring) is placed in the spindle-wheel groove.

Film is taken up in the Kodak and Maurer magazines by action of a gear drive (an integral part of the magazine).

The exterior spindle wheels on a gear-driven magazine are usually recessed in a housing with only finger holes or slots in the wheel diameter for taking up any slack in the magazine by hand. Theoretically, on some gear-driven magazines a brake is not necessary as

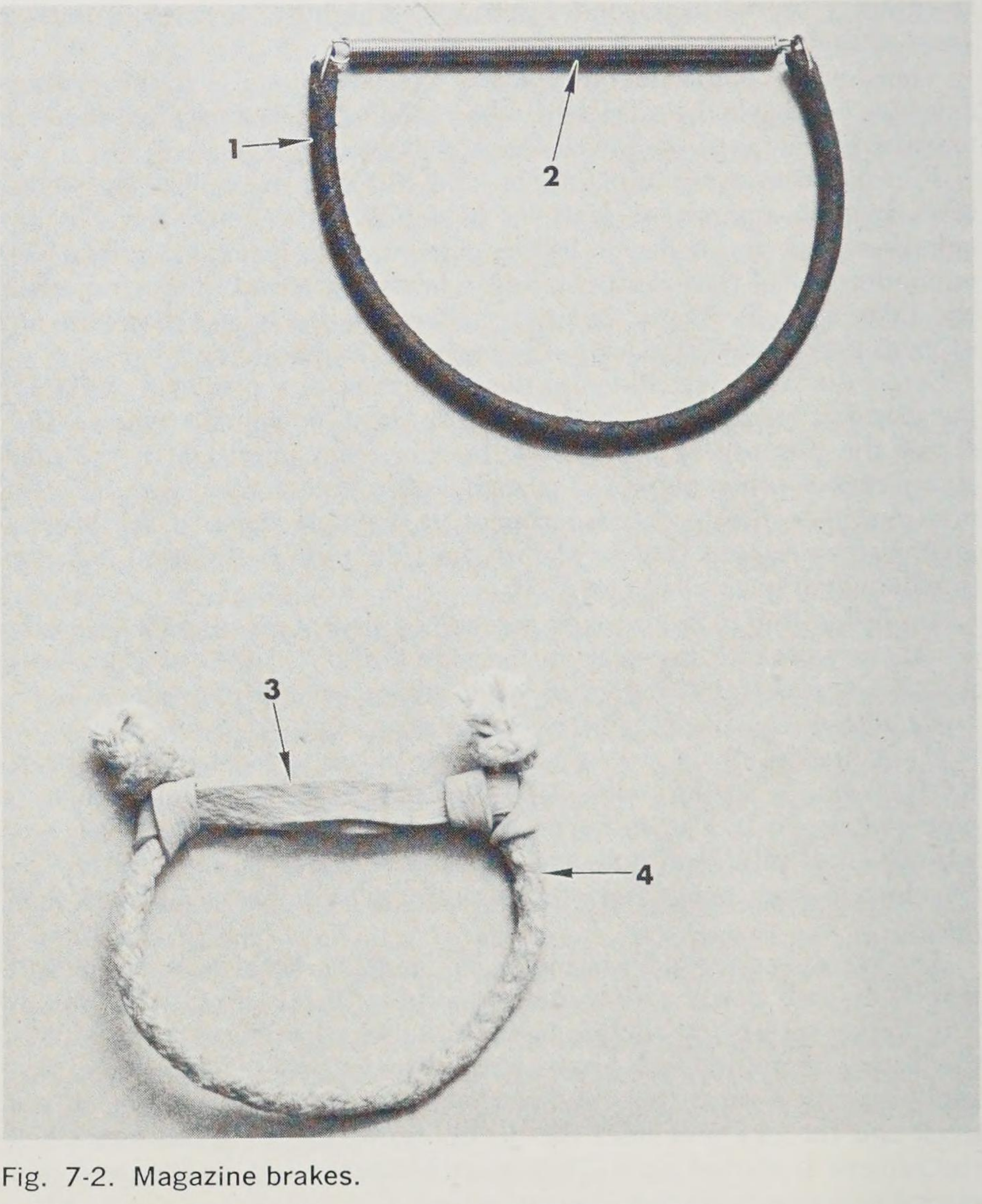


Fig. 7-2. Magazine brakes.

1. ⅛" diameter leather thong
2. 3/16" X .20 gauge wire
3. Rubber band
4. Sash cord

the raw stock on the feed side turns only at the same speed at which the take-up spindle rotates. However, due to some manufactures and/or the age of some particular magazine, a "free-wheeling" feed spindle is quite common. A powder puff (or reasonable facsimile—usually obtainable from the make-up department) pressed against the feed-spindle wheel and taped to the magazine will serve as a brake.

The displacement-type magazine (Arriflex, Cameflex, etc.). This type magazine has a single lighttight chamber. It is much more compact

than the tandem magazine. As the raw-stock roll diminishes, the take-up roll increases in size, thereby displacing almost the same area occupied by the raw-stock roll.

While most displacement-type magazines are gear-driven, some magazines require an additional torque motor to take up the film into the chamber.

These magazines are usually fitted with an exterior subtractive footage counter. One or more interior guide rollers ride the film edge and prevent the film from "dishing" in the magazine and scraping the interior magazine wall. One roller serves as the footage-counter indicator.

Exterior spindle wheels are usually knurled knobs. Some displacement-type magazines may have film-tensioner knobs in place of spindle wheels to take up film slack in the magazine by hand. Because they are gear-driven, unrolling is minimized, but not necessarily eliminated. Magazine brakes can be applied as with the gear-driven double-compartment–type magazine.

The coaxial-type magazine (Beckman & Whitley, Eclair NPR, Arriflex 1200, etc.). This type magazine is a double-compartment magazine with the feed and take-up chambers placed side-by-side instead of in tandem, with a concentric shaft accommodating both the feed and take-up rolls.

Coaxial-type magazines are gear-driven. Most (but not necessarily all) are fitted with an exterior footage counter, and two interior guide rollers. One roller serves as a footage counter.

The single-compartment–type magazine. This type magazine is constructed for special cameras. A single chamber may be used for either a feed roll or a take-up roll—i.e., a compartment containing raw stock is placed on one side of the camera, the film threaded into the camera, and then the film end wound on a core in another (take-up) compartment. In this way, a certain amount of film can be exposed, the take-up magazine removed from the camera without removing the raw stock and unthreading, a new take-up compartment placed on the camera, and filming continued.

7.7d Maintenance

As with other camera components, it is important that magazines be kept free of lint, dirt, and other debris. Interiors of magazines should be cleaned with an airhose. Where compressed air is not available, a bulb syringe may suffice.

Felt-lined magazines, however, often require cleaning with a short-bristled brush. Stubborn lint or film chips can be removed by wrapping a few turns of camera tape "inside-out" around one hand, then pressing the sticky side gently against the interior surface to be cleaned. All magazines are *always* cleaned before loading and after unloading.

Light traps must be kept free of dust and film chips. They should be checked and cleaned often. Although light traps are supposed to be lightproof, it is always good practice to carry a magazine with one

hand placed over the lighttrap when transporting it from case to camera.

When possible, the magazine throat should be opened periodically to properly clean the felt rollers. This is the area that produces most of the "hairs" in the camera gate; thus its cleanliness is very important, particularly in 35mm Techniscope and in 16mm, where the entire frame will be projected.

7.7e Miscellaneous

When *transporting loaded magazines* to a location it is important to: 1. Maintain the magazine in a vertical position with the light traps up, and of course, keep the magazine away from heat. 2. Place a lab-pack bag over the light traps and secure with tape. 3. Tape the feed and take-up spindle wheels to prevent the film from unrolling inside the magazine.

When working in extreme heat or direct rays of the sun, wrap and tape aluminum foil around the magazine, being certain that an air space is maintained between the magazine and the foil. The foil will reflect most of the sun's heat rays and the air space will act as an insulator.

To eliminate film scrape against the interior walls of a magazine, relieve a threaded lid 1/4 to 1/2 turn; a lip- and dog-locked lid requires removing the magazine from the camera and "jiggling" the gears while tilting the magazine opposite to the side the film is scraping. An occasional *tap* on the scraping side may also help seat the film in the guide roller.

> CAUTION: A sharp or heavy slap against a magazine in which there is a dished roll can cause lateral cinch marks in the emulsion; therefore, treat the magazine gently. If need be, return it to the loading room for reloading.

7.7f Lost cores

When a magazine lacks a core and no other cores are available, the following procedures will usually suffice:

35mm. On a magazine fitted with a plastic core spindle, load the feed side and thread the film end as usual into the take-up side. Fold the film back 6 in. from the film end and tape the film fold to the spindle. Tuck the film end into the taped fold and crease the film again; tuck the new film end into the creased film and crease again; repeat until the film can no longer be tucked into itself. Rotate the take-up spindle and wrap the raw stock around the film "pile." The film will take up with a "hump" in the roll. When unloading the exposed roll in darkness, the "pile" can be pulled out with needlenose pliers to loosen the roll around the spindle.

On a magazine fitted with a removable metal core spindle, purchase a bottle cork from any hardware store. If tapered, shave the cork into a cylindrical shape, making certain the diameter is at least 1 in. when finished. Cut the cork length slightly less than the depth of the

magazine, and use a screwdriver smaller than the diameter of the spindle to fashion a guide hole in the cork. The guide hole should only be as deep as the spindle *shank* (*less* the length of the "horns" of the metal groove). Push the cork onto the shank and anchor the horns into the cork. Tape the film to the cork and form a "core" by folding as above.

An alternative is to pressure-fit (wedge) a plastic core on the cork and then wedge a sliver of wood into the cork and core keyway.

16mm. If fitted with a removable core holder, remove the holder, insert the film end into a 100-ft camera spool. Place the spool on the square driver pins of the take-up spindle. Let the take-up roller-guide arm ride against the spool on displacement-type magazines—as the roll increases in size it will "pick up" the exposed film and guide it.

Make a note to the laboratory that a spool has been used as a take-up core.

If fitted with nonremovable plastic core spindle, use the same procedure as with the 35mm magazine.

7.7g Core-differential compensation

When loading a short end from a 16mm x 1200-ft roll into a 400-ft magazine, the difference in core diameter must be taken into account (1200-ft rolls are factory-wound on 3-in. cores; 400-ft rolls are factory-wound on 2-in. cores). Therefore, on a 3-in. core loaded into the feed side of a magazine, the total footage as registered on a subtractive magazine counter will read 60 ft higher than normal. All footage computations will have to be minus 60 ft.

A note should be placed below the magazine footage counter stating: "3-in. core—deduct 60 ft."

CHAPTER 8

Tripods

A tripod is a telescoping three-legged stand used to support a movable platform (tripod head) to which a camera is secured.

8.1 TRIPOD TYPES

There are four basic types of tripods (Fig. 8-1):

1. *Standard legs:* Approximately 4 ft when closed; approximately 6 ft when extended. 2. *Sawed-off legs:* Approximately 3 ft when closed; approximately 5 ft when extended. 3. *Baby (low) legs:* Approximately 2 ft when closed; approximately 3 ft when extended.

NOTE: The length of each unit above has a ± factor of 6 in.

4. *Hi-hat:* Approximately 4–6 in. high; nontelescopic.

NOTE: Each leg of this low mount has a flange (instead of shoes). Each flange is fitted with a drilled hole so that the unit may be mounted with nails or screws where a tripod cannot be used.

8.2 THE BASIC PARTS OF A TRIPOD

Top casting. This is the round metal plate with a center hole, which accepts the tripod-head lockdown screw. A keyway at the top of the casting matches the key on the tripod head. Three hinges at the bottom of the casting accept the bolts (which are inserted through metal straps attached to the top of the tripod legs), which secure the legs to the top casting.

Most top castings are fitted with three tie-down eyes (drilled holes in the casting, or metal loops) next to or below the hinges.

Some top castings are bowl-shaped to accommodate a ball-type (adjustable) tripod head.

Legs. Almost always of wood, each leg has an outside and inside assembly. The hinge nut and bolt which secures each leg to the top casting may be adjusted. Proper tension is set by tightening the hinge nut until the leg can be (1) swung *easily* up and away from the top casting, (2) released, and (3) remain at the angle to which it was lifted. Insufficient tension ("slop") allows the legs to drop away from the casting when carrying the tripod; too much tension ("drag") requires undue exertion in opening the legs when setting up the tripod.

Adjusting knobs. These are circular units (single or double) placed between the leg assemblies. They loosen to raise or lower the inside-leg assembly, tighten to secure the leg against the outside assembly. Some baby tripods use thumbscrews instead of knobs.

Shoe. The metal unit at the foot of each leg. Each shoe has at least one of the three following parts:

1. *Point:* A sharp tapered metal unit at the toe of the shoe which digs into the ground, floor, or spreader to prevent the leg from sliding.

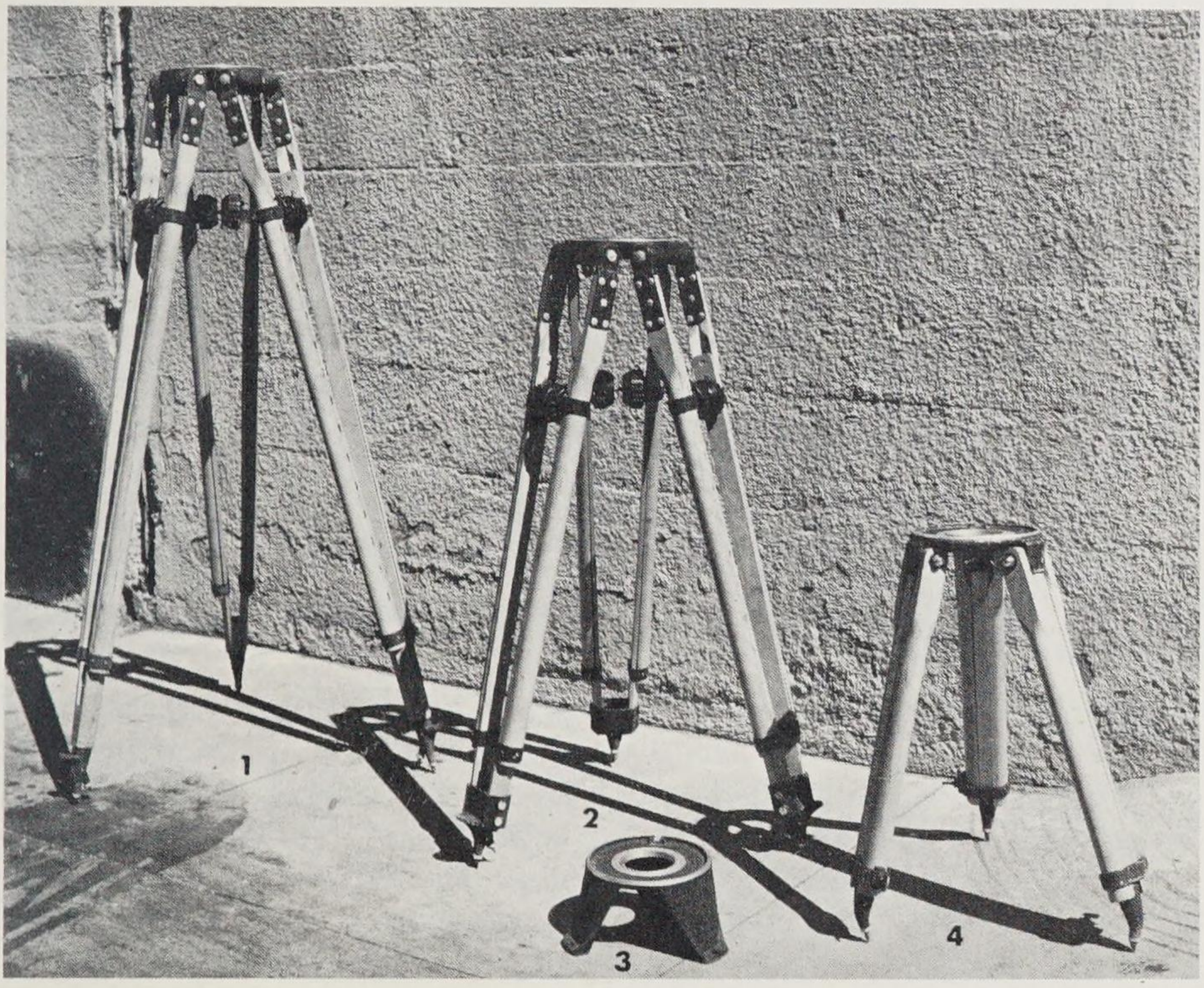


Fig. 8-1. Tripods and hi-hat.

1. Standard legs
2. Sawed-off legs
3. Hi-hat
4. Baby (low) legs

2. *Spur:* A sharp tapered metal unit similar to a point, but positioned on the inside of the shoe at an angle to the point. It may be close to the point or approximately one-third higher on the shoe. The spur acts as a point when the tripod leg is swung outward on its hinge to an angle beyond which the point can safely secure the tripod leg.
3. *Kickplate:* A protruding piece of metal on the outside of the shoe; the kickplate is used as a step to sink the point into the ground or to anchor the shoe when elevating the tripod leg.

An important accessory is a rubber pad encased in a suitable leather (or fabric) envelope attached by a cord to the top casting. The pad cushions the weight of the camera when the tripod is carried from one setup to another.

NOTE: A 35mm tripod is heavier and larger in component size than a 16mm tripod. A 16mm camera may be safely used on a 35mm tripod; however the balance of a "spring-tension" tripod head (which is intended for a heavier instrument) may work against the Operator. The use of a 35mm camera on a 16mm tripod is not recommended as the entire unit becomes top-heavy and can easily tip over.

8.3 SETTING TRIPOD FOR SHOOTING

8.3a Uniform leg length

Bring the tripod legs together into the folded position as though to place them in a shipping case. Extend one leg to the desired length and tighten. Keep the legs in the folded position, loosen the other two legs, and allow their points to drop to the ground; tighten adjusting knobs. When the legs are spread out equidistant, the tripod head will be very close to level.

The camera lens is always aligned to one leg which becomes the vertex of the triangle formed by the spread legs. The vertex of the triangle (always called "the forward leg") is pointed at the scene. The left-rear and right-rear legs at the back of the camera are far enough apart to permit the Operator to move around the tripod with minimal interference.

8.3b Leveling

Place the horizontal bar of the tripod head T-level in line between any two legs. Step on the kickplate; level with one of the three legs. Adjust the third leg up or down to center the bubble of the vertical bar of the T-level. The tripod head is now level (see Fig. 8-2).

This method is the fastest procedure with any tripod, and is particularly effective when leveling a heavy camera.

Often the tripod head can be leveled by simply rotating one leg in an arc.

Many tripods have numbers imprinted on at least two of the leg assemblies. Theoretically, when two legs are locked off at the same number, only one leg needs adjusting to level the camera. This is true only if all three points are equidistant from each other (form an equilateral triangle).

8.4 MOVING A TRIPOD

To minimize strain and inefficiency there are three basic steps to moving a tripod from one setup to another: (1) lift; (2) balance; (3) placement.

1. *Lift*. Place the camera at eye level. Raise the tripod-head handle to approximately a 45° angle. Align the camera lens to the forward leg. Step *between* the two rear legs. Place the shoulder pad against the back of the tripod head, below the camera. Bend the knees slightly and place the right shoulder against the pad. Lengthen the forward leg approximately 4 in. and tighten. (This tilts the camera back against the right shoulder.) Grasp the adjustable knobs of both rear legs with each hand. Push forward with the right shoulder and lift up on the rear legs so as to pivot on the forward leg only. Fold in the two rear legs to meet the forward leg. Straighten the knees and lift the camera off the ground.

CAUTION: Always make certain the tripod-head pan and tilt locks are secured before lifting the tripod!

2. *Balance*. Once the camera is lifted, place the right arm around all three legs, or through the right-rear-leg and forward-leg assemblies. Use the shoulder as a fulcrum and raise or lower the points to maintain fore-and-aft balance. Lean from the waist, toward the left, to maintain side-to-side balance.

3. *Placement*. Make certain the forward leg is extended 4–6 in. Grasp the adjustable knobs of the two rear legs. Bend the knees slightly and set the point of the forward leg into the ground. Spread the two rear legs out and back from the forward leg and plant them into the ground. Lower the extended forward leg to level the camera.

8.5 CARE AND MAINTENANCE

8.5a Shipping

Tripods should be shipped in cases for protection against damage. At a minimum, a boot (i.e., a two-piece unit that protects the shoes

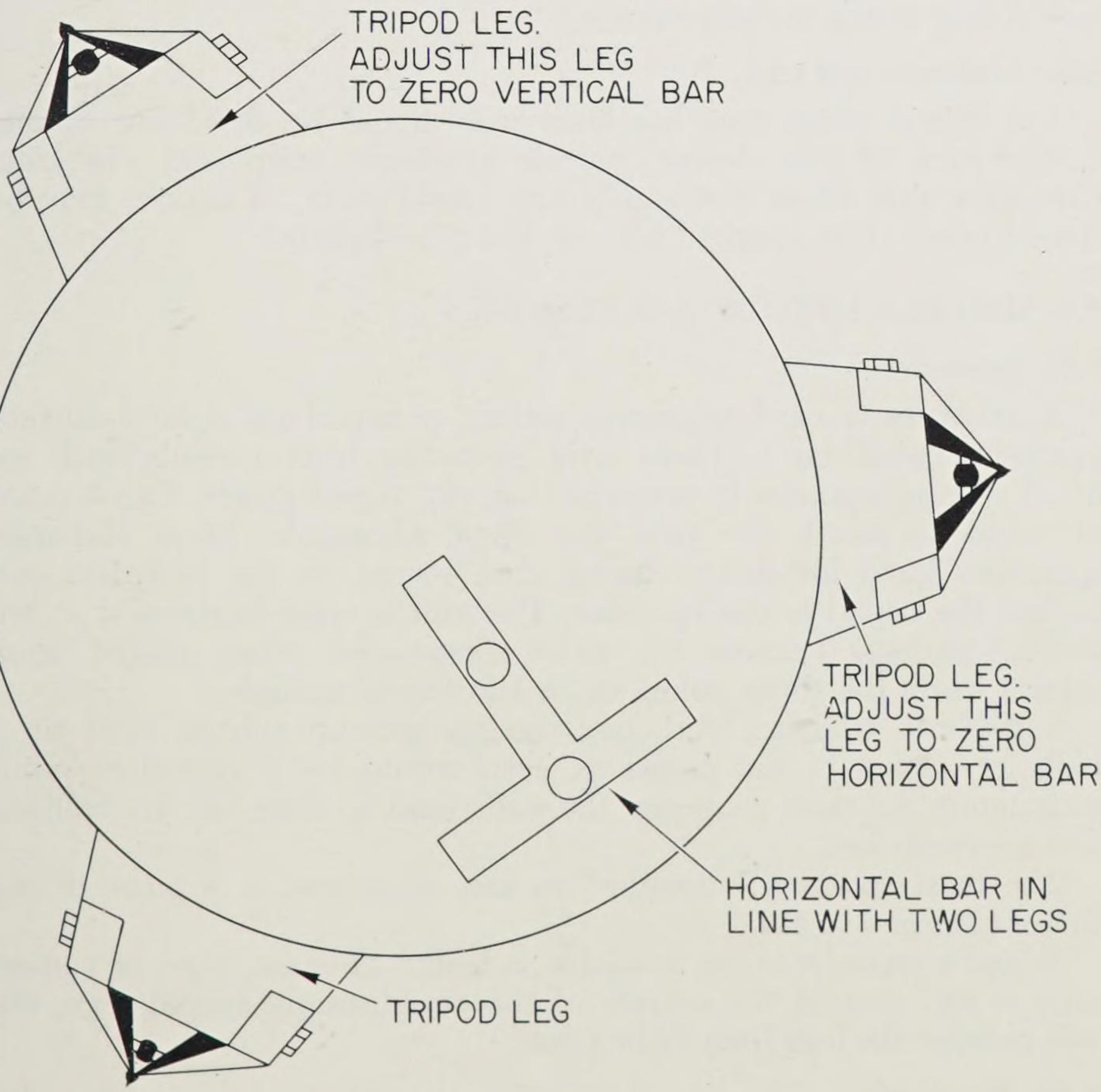


Fig. 8-2. T-level.

and top casting, but not the legs) should be used. In an emergency, cardboard boxes are fitted over the shoes and top casting and secured with camera tape. For some unfathomable reason, often more care is given to protecting the shoes than the top casting. A tripod with a shoe completely broken off can still be leveled, but a cracked or broken top casting will render the entire unit useless.

8.5b Lubrication

The use of commercial paste or liquid waxes is not recommended for tripods because of their propensity to retain grit and dirt. A light application of hard beeswax cake or silicon spray (from a pressurized can)—to the outside of the inner-leg assembly *only*—is sufficient. Allow to dry before "pumping" the assembly up and down, so that the wax will "rub off" and lubricate the outside-assembly highspots.

A "sticky" tripod can result from too much lubricant applied to both sides of the leg assemblies, as well as from not enough lubricant. (Two waxed surfaces collect dirt and grit faster than one waxed surface sliding over a smooth surface.)

8.5c Moisture and rust

Any tripod wood that has been wet should be dried out *slowly*. Acceleration of the drying process produces warp and checking. Lubricate only when thoroughly dry. Metal parts, of course, may be dried immediately, checked for rust, and oiled lightly.

8.6 MISCELLANEOUS ACCESSORIES

8.6a Spreader

A *spreader* is used whenever setting a tripod on a hard surface (cement, metal, etc.). Three arms extending from a centerblock are fitted with receptacles to accommodate the tripod points. Constructed of wood or metal, the arms are often adjustable. More elaborate spreaders have lockdown clamps that secure to the kickplate and anchor the tripod to the spreader. The unit is often mistermed a "triangle," perhaps because the point receptacles, when placed equidistant, form the three points of an equilateral triangle.

Sometimes rubber "feet" i.e., semisuction-cup rubber pads on a balljoint, fasten to the points as a substitute for a spreader. While satisfactory for most purposes, the pads tend to come off the balljoint and are easily lost.

The most common "spreader" in use, of course, is a piece of rug that measures 4 × 4 ft.

When a spreader is not available, a length of chain, rope, or camera tape is tied around the outside of the equidistantly spread legs; this will prevent the legs from sliding out.

8.6b Tie-down

Used on raised platforms, camera cars, and other areas where the danger of tipping the camera over is present, the *tie-down* consists of

a piece of chain 6–8 ft long attached at one end to three short (7–9-in.) lengths of chain called the *bridle*. Each short length terminates in an S-hook. Each S-hook inserts into a tie-down eye located at the bottom of the top casting. The 6–8-ft length of chain dangles from the center of the bridle to the floor. A stage screw is secured to the floor directly below the center of the tripod head. A double-hooked turnbuckle is then attached to the chain and stage screw and tightened sufficiently to apply tension to the chain and keep the tripod from tipping over.

CHAPTER 9

Tripod Heads and Accessories

9.1 TYPES OF TRIPOD HEADS

There are many types and makes of tripod heads available to Cameramen. This chapter will consider the friction, fluid, and geared heads. Space requirements permit only the treatment of the Mitchell friction head, O'Connor fluid head, and the Worrall geared head. No endorsement by inclusion, or discredit by omission of other tripod heads, is intended.

1. The *friction head* employs the principle of surface resistance. The friction of fiber discs against metal washers creates "drag" on the lateral and vertical movements of the head. 2. The *fluid head* employs the principle of fluid resistance. The restricted flow of a high-viscosity liquid forced through grooves machined inside a metal drum creates "drag" on the lateral and vertical movements of the head. 3. The *geared head* employs the principle of mechanical advantage. The ratio of the angular speed of driving members to driven members of a gear train creates "force" against the lateral and vertical movements of the head.

A friction or fluid tripod head which has the handle placement at its left side is constructed for use with an offset-viewfinder camera; a head which has the handle placement at its right side is constructed for use with a reflex (through-the-lens-viewing) camera.

Some heads allow for handle placement at both sides and may be used with either type camera.

The geared head is intended for use with an offset-viewfinder camera.

With a left-handled tripod head, the Operator takes a stance behind the offset viewfinder and grasps the handle with his right hand. This places him away from the tripod legs and provides him with greater freedom of movement, as well as better "balance" of the camera.

With a right-handled tripod head, the Operator "hugs" the camera in order to place his eye to the viewing system. The placement of the handle compensates for the Operator's closeness to the camera and will not interfere with his movements. Its position will also provide him with better "balance" of the camera.

With a geared head, the Operator stands behind the offset viewfinder, takes a three-fourth stance toward the camera, reaches forward with his left hand for the pan handle, and reaches out with his right hand for the tilt handle located at the rear of the head. In this position, his body is clear of the tripod legs for ease of movement and "balance."

Proper selection of a tripod head predicated upon the camera viewing system will eliminate "fighting" the head, and allow the Operator

to concentrate more on the creative aspects of composition and camera movement.

In addition, the Operator must be so familiar with the components of the tripod head he is working with that, as with his camera, his handling of it does not require conscious thought but, rather, is automatic.

9.2 MITCHELL FRICTION HEAD

The two basic components of the Mitchell friction head are: (a) the plate; (b) the base. (See Fig. 9-1.)

9.2a The plate

The top surface of the cast-steel plate measures 7 in. wide by 8 in. long. The spring-loaded ⅜"-16 *camera lockdown screw* (1) is connected by a pair of helical gears (not shown) to a knurled *lockdown screw knob* on a shaft (not shown) at the front of the head. The lockdown-screw-knob shaft is also fitted with a steel taper pin to which a keyed *hand crank* (not shown) is matched to secure the lockdown

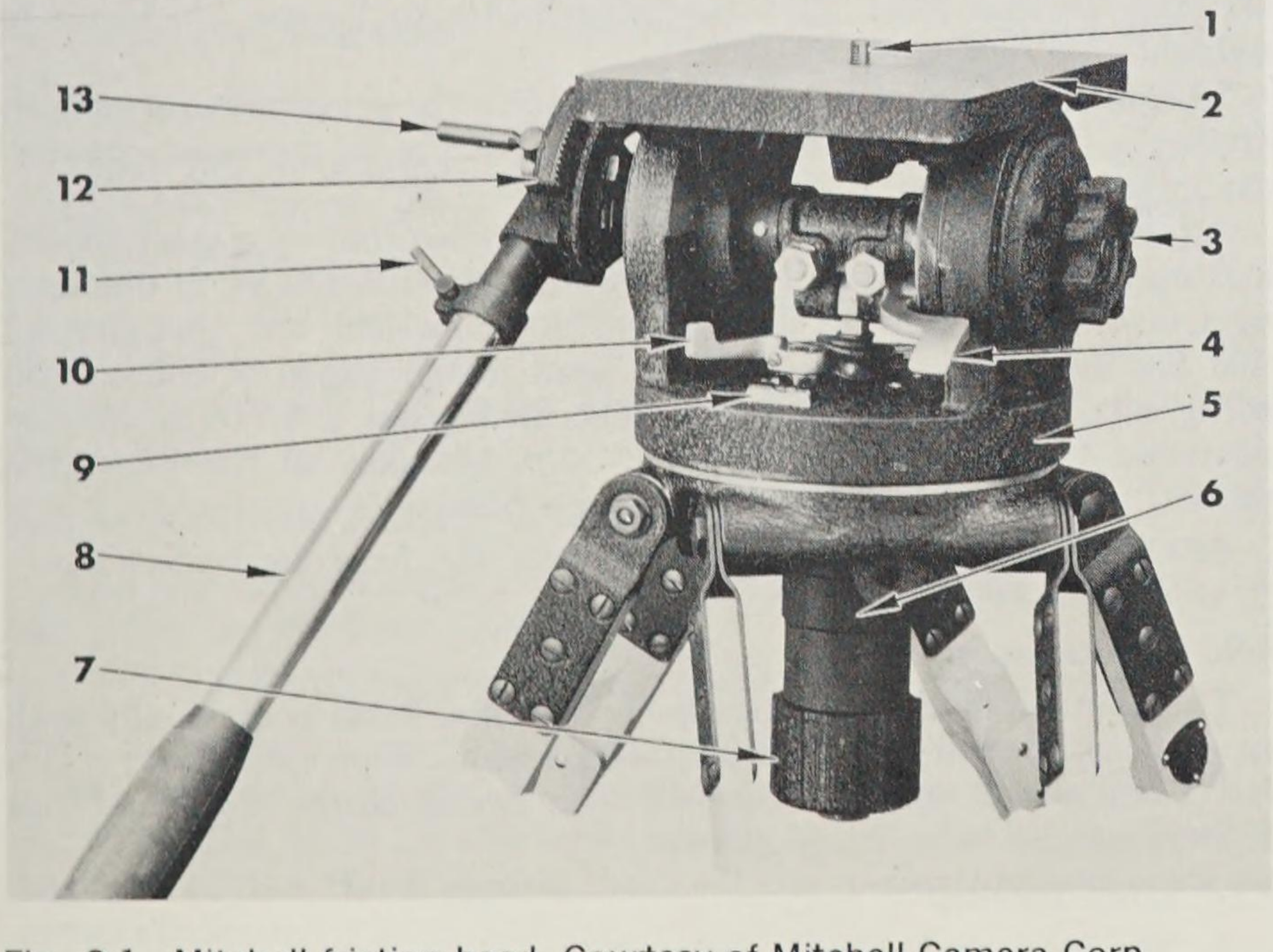


Fig. 9-1. Mitchell friction head. Courtesy of Mitchell Camera Corp.

1. Camera lockdown screw
2. Plate
3. Tilt tension knob
4. Tilt lock lever
5. Base
6. Pan-tension-knob collar
7. Pan-tension knob
8. Telescoping handle
9. Bubble level
10. Pan lock lever
11. Handle lock
12. Handle bracket
13. Bracket lock lever

screw tightly. Rotating the lockdown screw knob clockwise tightens the screw; turning it counterclockwise loosens it.

The plate brake release is actuated by turning the *tilt lock lever* (4—below the plate at the right) counterclockwise to loosen, clockwise to lock.

Elevation/depression "drag" is controlled by turning the scalloped *tilt tension knob* (3) counterclockwise to decrease, clockwise to increase.

The *handle bracket* (12) at the left side travels in a restricted slot and secures at a desired angle (from 45° high, to 45° low) by turning the *bracket lock lever* (13) counterclockwise to mesh the bracket lock teeth with the matching teeth on the head.

The stud and threads of the rudder on the *telescoping handle* (8) insert into the bracket 2-1/2 in. deep. The handle measures 19 in. overall when closed, and may be extended to 26-1/2 in. overall when the *handle lock* (11) is loosened counterclockwise.

9.2b The base

The base brake release is actuated by turning the *pan lock lever* (10)—at the top of the base and forward of the two-way (horizontal/vertical) *bubble level* (9)—counterclockwise to loosen, clockwise to tighten.

Horizontal "drag" is controlled by turning the scalloped *pan tension knob* (7—below bottom of the base) clockwise to increase, counterclockwise to decrease.

Attached to the bottom of the 7-in.-diameter base is a steel tripod-locking screw (not shown). The screw measures 2-5/8 in. in diameter by 1 in. in length, with 8 threads per inch. The lock nut (not shown) that fits the screw and clamps the head to the tripod is constructed with "ears" to aid in loosening the nut, which has a 3-7/8-in. outside diameter, from the screw. The 3/8 × 3/4-in. key at the base (not shown) inserts into a mating slot on the tripod.

NOTE: The plate depresses and elevates 45° from the center; the base rotates 360°.

9.2c Maintenance

The manufacturer recommends: wipe entire head occasionally with an oily rag containing a rust-inhibiting agent. Wipe clean with a dry rag. Surface rust is to be removed with crocus cloth. Worn bushings or locks require factory replacement.

9.2d Miscellaneous

1. The *pan-tension-knob collar* (6) may contain a standard tension spring (intended for use with the Standard and high-speed, NC, or S35R camera) or a heavy-duty spring (intended for use with the BNC, blimped Mitchell 16, or other blimped non-Mitchell manufacture cameras). The type of spring required is determined by the camera to be used.

2. If the length of the camera lockdown screw fails to secure the camera tightly to the plate, a few strips of camera tape placed across the top of the plate will act as an "anchor" and eliminate any slippage of the camera.

3. If damage or loss occurs in the field, the screw/nut table (Table 9-1) may expedite repair.

4. Mitchell also manufactures a 16mm friction head.

TABLE 9-1

MITCHELL SCREW/NUT TABLE

Item	Type Screwhead	Thread and Length
Pan and Tilt Lock Levers	Fillister	8-32 x 3/4"
Handle Bracket Screw	Fillister	10-24 x 5/8"
Bubble-Level Screw	82° countersink flat	3-48 x 3/16"
Plate Screw	82° countersink flat	1/4-20 x 7/8"
Tilt-Tension-Knob Screw	Pan Head	10-32 x 7/16"
Base Key Screw	82° countersink flat	6-32 x 3/16"
Taper Pin on Camera Lockdown Shaft (fits crank handle)	(none)	3/0 x 3/8" (no threads)

9.2e Weight

Standard head, 18-1/2 lb; BB (ball bearing head), 27 lb; 16mm head, 13 lb.

9.3 O'CONNOR FLUID HEAD MODEL 100B

The two basic components of the O'Connor Fluid Head are: (a) the plate; (b) the base. (See Fig. 9-2.)

NOTE: All directions are from the Operator's point of view.

9.3a The plate

The top surface of the cast-aluminum-alloy plate measures 5-1/8 × 5-1/8 in. The ⅜"-16 *camera lockdown screw* (4) can be positioned in any one of the three tandem holes in the plate to compensate for camera balance.

To change the lockdown screw, remove the Allen screw in the scalloped lockdown screw knob (below the plate) and pull the ⅜"-16 screw *up*.

CAUTION: To be certain the Allen screw tightens on the milled flat surface when reassembling, align the slot on the top of the lockdown screw with the Allen screw and tighten.

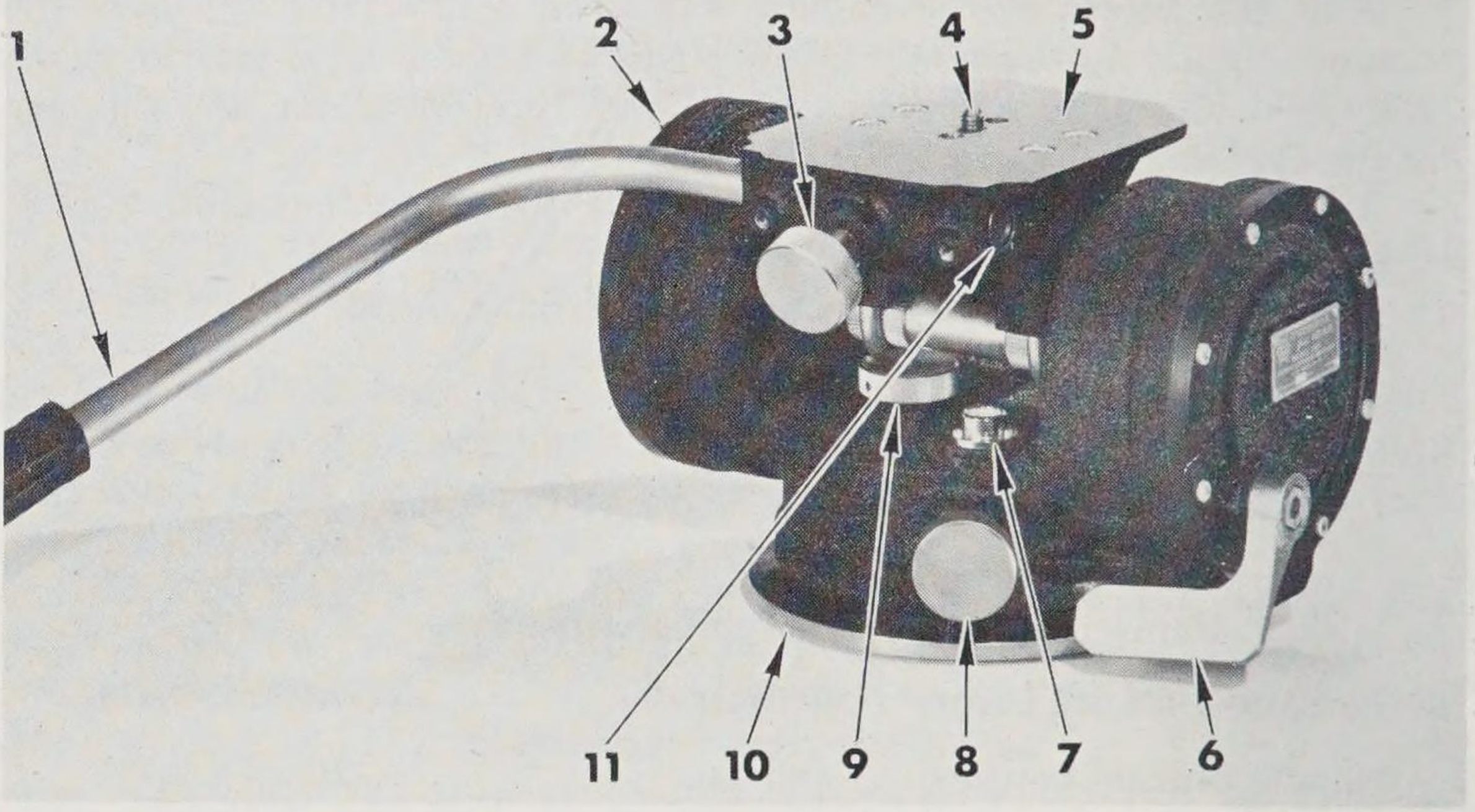


Fig. 9-2. O'Connor fluid head. Courtesy of O'Connor Engineering Laboratories.

1. Handle
2. Tilt tension knob (not visible)
3. Handle lock knob
4. Camera lockdown screw
5. Plate
6. Tilt brake lever
7. Bubble level
8. Pan brake knob
9. Pan tension knob
10. Base
11. Handle spline

The spring-loaded camera lockdown screw rotates clockwise to tighten, counterclockwise to loosen.

The *handle* (1) *always* inserts into the *handle spline* (11) with the *handle lock knob* (3) facing the Operator and handle extending toward the Operator. The handle may be adjusted to any desired angle from 45° high to 45° low; a 3-in. lateral adjustment is also possible. The handle inserts in either the left or right side of the spline.

CAUTION: Inserting the handle backwards—i.e., handle extending toward the Operator but lock knob facing away from the Operator—will damage the spline when the lock knob is tightened.

NOTE: For a handlebar arrangement, two handles are inserted into the spline from opposite sides until they touch in the center, and then are secured by two ¼"-20 x ⅜" set screws in the tapped holes provided.

9.3b The base

The golf-club–shaped *tilt brake lever* (6) on the right-hand drum is pushed forward to loosen and backward to tighten the disc brake lock.

NOTE: (a) On some models the golf-club–shaped brake handle may be replaced with a knurled brake knob that rotates clockwise to tighten, counterclockwise to loosen. (b) On earlier models the brake is the lower knurled knob closest to the Camera Operator on the *left* drum.

Elevation/depression "drag" is controlled by turning the knurled *tilt tension knob* (2) on the top of the left drum, counterclockwise to decrease, clockwise to increase.

The knurled *pan brake knob* (8)—below the bullseye *bubble level* (7)—is turned counterclockwise to release and clockwise to tighten the base brake lock.

Horizontal "drag" is controlled by turning the knurled *pan tension knob* (9)—next to the bullseye level—counterclockwise to decrease, clockwise to increase.

At the bottom of the 7-in. diameter base is a ⅜"-16 tapped hole (not shown). A scalloped-knob tripod-locking screw (2 in. in length) inserts through a 3-1/4-in. lock washer (neither shown) and into the tapped hole in the base to clamp the head to the tripod.

NOTE: The plate tilts plus or minus 60° from horizontal; the base rotates 360°.

9.3c Maintenance

The manufacturer states: Do nothing except to "respect it as a piece of equipment while using it." Oil is detrimental to the seals which retain the silicone fluid. The manufacturer further claims "all surfaces are inert to almost all atmospheres short of acid"; therefore rust-inhibiting agents are unnecessary.

9.3d Miscellaneous

1. The manufacturer provides heads with one of three counterbalance-spring combinations. The right-hand drum on the head houses the counterbalance spring. The manufacturer attaches a nameplate to the drum which classifies the torque of the spring (in inch-pounds) that is inside the drum. The three settings used are: 300 in-lb; 500 in-lb; 700 in-lb.

NOTE: An inch-pound is a standard unit of measurement for torque. To determine inch-pounds: measure the distance (D) in inches from the tilt shaft to the center of gravity of the camera; multiply this by the weight (W) of the camera in pounds (D × W = inch-pounds of torque).

The spring's torque (in inch-pounds) should be less than the above figure. For example: if the total weight of the camera is 65 lb and the distance from the pivot point on the head to the center of gravity of the camera is 10 in., the product equals 650 in-lb of torque. Therefore, the head to use in this case would be one with a counterbalance-spring setting of 500 in-lb. If a spring's torque is *more* than the product of D × W (e.g., a 25-lb camera with a c/g of 10 lb—total 250 lb—placed on a 300 in-lb head) the Camera Operator will find himself "working against" the spring and experience great difficulty every time he attempts to tilt the head.

CAUTION: The manufacturer warns that any attempt to remove the counterbalance spring from its housing can be *extremely dangerous.*

2. If the camera lockdown screw fails to secure the camera tightly to the plate, a few strips of camera tape placed across the top of the

plate will act as an "anchor" and eliminate any slippage of the camera on the plate.

3. If damage or loss occurs in the field, the screw/nut table (Table 9-2) may expedite repair.

4. O'Connor also manufactures a fluid head for small cameras and TV cameras, and a missile-tracking head and pedestal.

TABLE 9-2

O'CONNOR SCREW/NUT TABLE

Item	Type Screwhead	Thread and Length	Allen Wrench Size
Camera-lockdown-screw knob	Allen set	10-32 x 1/4"	3/32
Handle-lock-knob set screw	Allen set	10-32 x 1/4"	3/32
Tilt-brake-lever set screw	Allen set	6-32 x 3/16"	1/16
Tilt-brake-lever nut	—	3/8"-16 i.d. x 9/16" o.d.	
Tilt-tension-knob screw	Allen set	6-32 x 3/8"	1/16
Pan-brake-knob set screw	Allen set	10-32 x 1/4"	3/32
Pan-tension-knob set screw	Allen set	6-32 x 3/8"	1/16
Tripod-lockdown screw	Allen set	3/8-16 x 2"	3/16
Tripod-lockdown-screw knob	Allen set	10-32 x 1/4"	3/32
Head-to-base screw	Allen Hd. Cap	1/4-20 x 7/8"	5/16
Base-key screw	Fil. Hd. Cap	4-4 x 3/8"	1/16
Bubble-level screws	Allen Hd. Cap	2-56 x 1/4"	5/64
Camera-platform U-bolts	Allen nut	5/16-24	5/16
Cover-plate screw	Allen Hd. Cap	10/24 x 1/2"	5/32
Handle spline	Square	1/4-20 x 3/8"	—

9.3e Weight. 20 lb.

9.4 WORRALL GEARED HEAD

The three basic components of the Worrall Geared Head are: (a) the cradle; (b) the carriage; (c) the base. (See Figs. 9-3(a) and (b).

NOTE: Tilt Handle (at back of base) faces Operator. Pan handle is at left of base. All directions are from the Operator's point of view.

9.4a The cradle

The top surface of the cast-aluminum *cradle* (3) measures 15-3/4 × 9-1/4 in. Before a camera can be placed on the cradle, the *adjustable*

side stops (2) must be relieved to permit side movement of the camera while securing the ⅜″-16 *camera lockdown screw* (4) into the tapped hole in the camera base. The camera lockdown screw can slide a distance of 2-1/2 in. in a restricted slot in the top of the cradle as an aid in engaging the tapped hole in the camera base; also, when the camera lockdown screw is loosened a few turns, the camera can be moved forward or backward to balance it on the cradle.

A pair of helical gears (not shown) connects the camera-lockdown screw to the *lockdown screw shaft* (5). The milled surfaces of the shaft accept a handcrank; on some models the shaft may be fitted with a permanent knob. Turning this shaft clockwise tightens the screw; rotating it counterclockwise loosens it.

Once the camera is secured to the cradle, the adjustable side stops are screwed in to engage the side of the camera base and prevent it from swiveling on the cradle surface.

The cast bronze *tilt gear* (1) engages a worm gear (not shown) attached to the tilt handle which elevates or depresses the cradle.

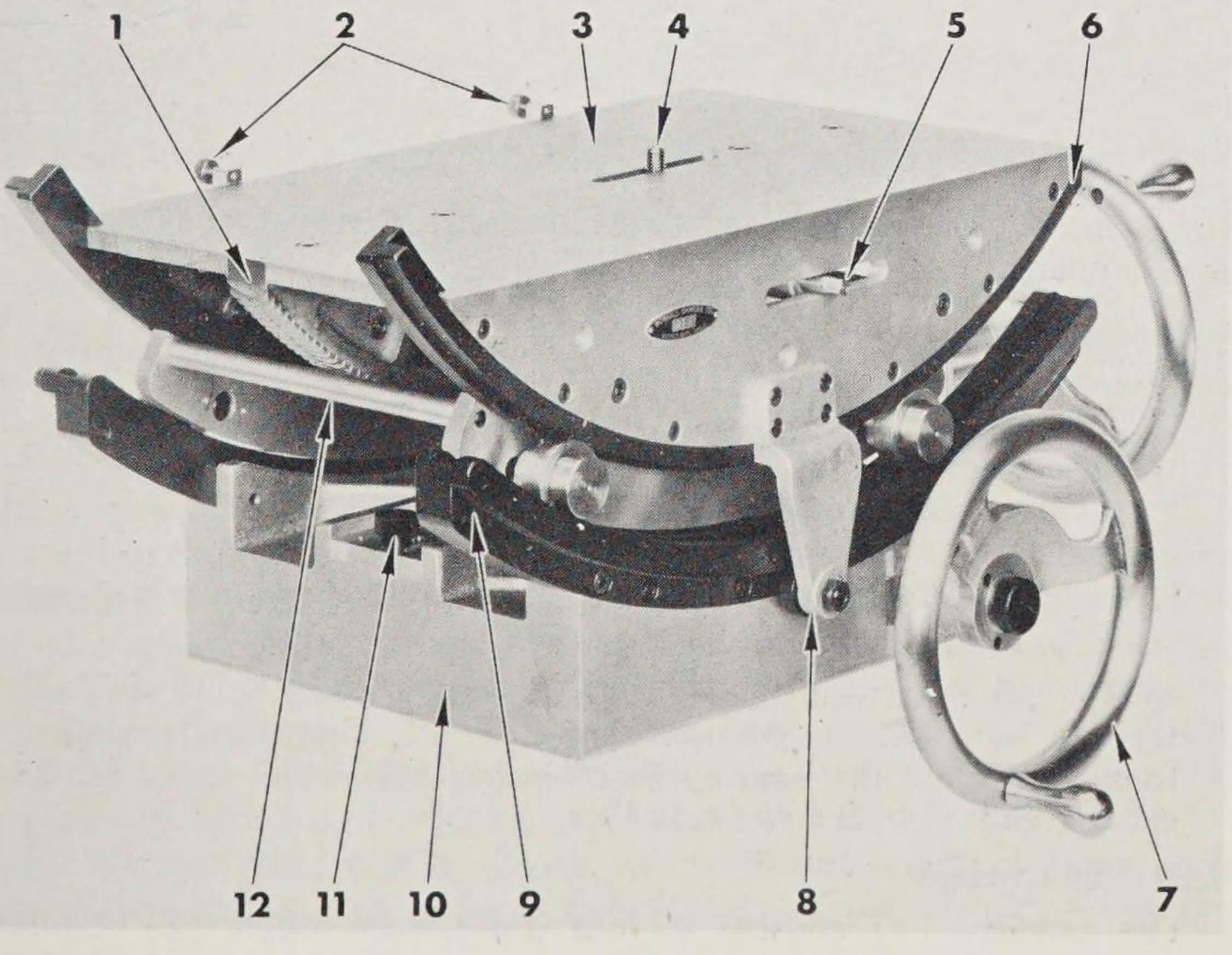


Fig. 9-3a. Worrall geared head (left front). Courtesy of Worrall Camera Company.

1. Tilt gear
2. Adjustable side stops
3. Cradle
4. Camera lockdown screw
5. Lockdown screw shaft
6. Upper rails
7. Pan handle
8. Side bracket
9. Bracket stop
10. Base
11. Tilt worm-lock cap
12. Carriage rod

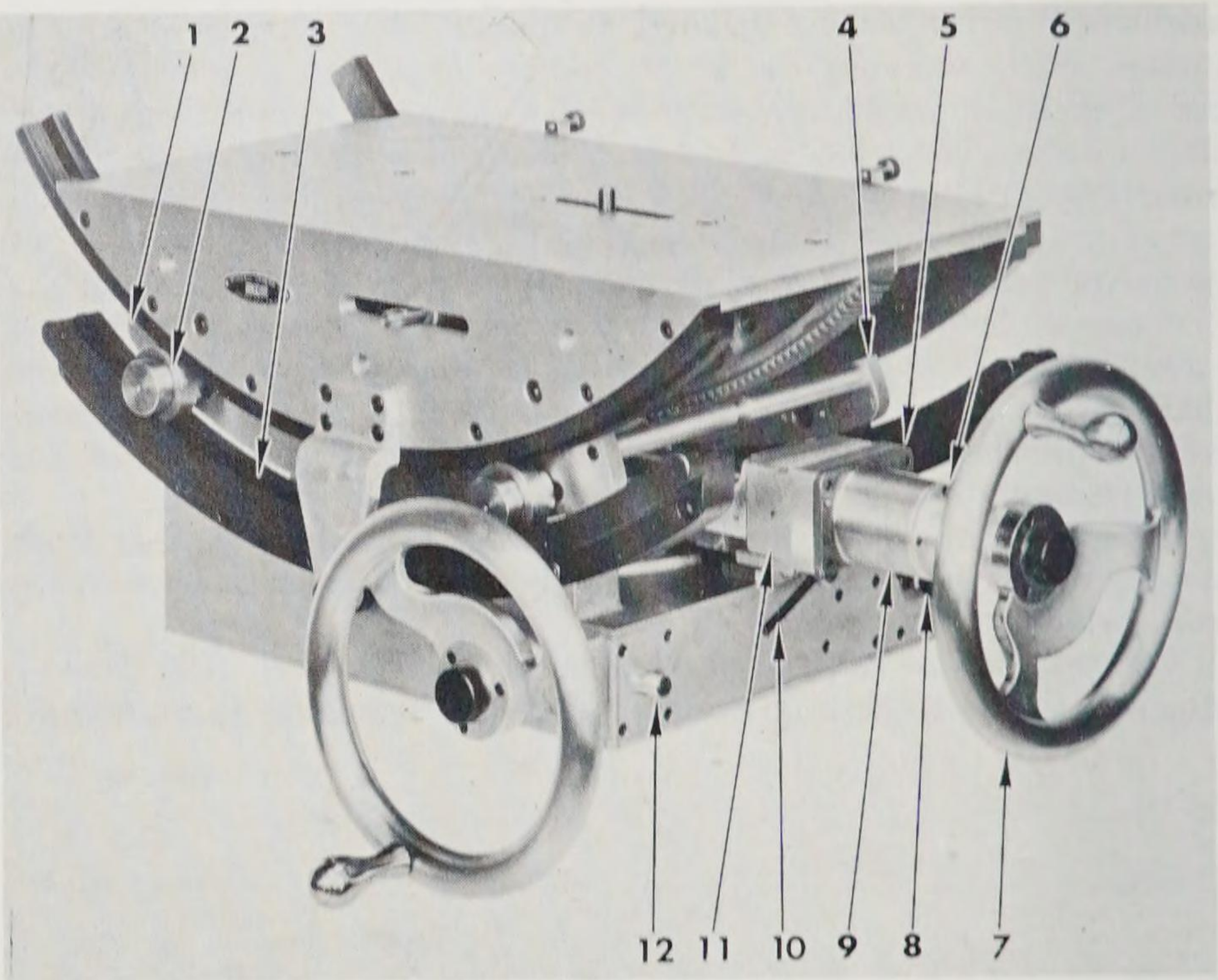


Fig. 9-3b. Worrall geared head (left rear view). Courtesy of Worrall Camera Company.

1. Carriage rail
2. Differential roller
3. Lower rail
4. Carriage
5. Tilt-speed selector (not visible)
6. Pan brake (not visible)
7. Tilt handle
8. Pan gear access knob (partially obscured)
9. Tilt drive shaft
10. Tilt brake
11. Tilt gear box
12. Pan-speed selector

The *upper rails* (6) ride on the *carriage* (4) and are stepped to prevent the cradle from moving sideways.

NOTE: All three components (cradle, carriage, and base) are held together as a unit by two *side brackets* (8), which are prevented from rocking off the base by four *bracket stops* (9) located at the extreme ends of both *lower rails* (3).

9.4b The carriage

The *carriage* (4) consists of four *differential rollers* (2) mounted on ball-bearing shafts screwed to two *carriage rails* (1) that are connected by two *carriage rods* (12). The differential rollers ride in the groove of the lower rail and the step of the upper rail. The carriage supports the cradle in its travel forward (tilt up) and/or back (tilt down).

9.4c The base

A pattern of nine holes in the *lower rails* (3) allows for a three-

position adjustment of the rails (forward, center, or back) to obtain a maximum elevation or depression of the cradle (42° from center). The rails are held in position (forward, center, or back) by ¼″-20 × ⅞″ socket-head cap screws which require a 3/16-in. hex wrench to remove. Normally, the rails are in the center position.

To adjust the lower rail with the camera on the cradle: remove the socket-head cap screws (two to three in each rail) with a 3/16-in. hex wrench; lift up on the cradle at the side bracket to support the weight of the camera; slide each lower rail to its new position (back to obtain maximum depression, center for normal position, and forward to obtain maximum elevation) until a combination of three screw holes in the rail match a combination of three tapped holes in the base; reinsert the screws in the matching tapped holes. If a third screw is available, insert it in the center tapped hole.

To disengage the tilt gear at the front of the base: turn the *tilt worm-lock cap* (11) counterclockwise, slide the wedge forward, then push the worm gear (not shown) *down*; slide the wedge back to its original position and tighten the tilt worm lock. When disengaged, the geared head is set for free tilting.

The *tilt gear box* (11) houses the two-speed *tilt-speed selector* (5). For low gear, move the selector forward; for high gear, move the selector back; to disengage gears, center the selector.

The *tilt drive shaft* (9) extends from the back of the base in order to clear the handle from the cradle. Directly below is the *tilt brake* (10) which is turned clockwise to lock, counterclockwise to release.

The two-speed *pan-speed selector* (12) is located at the left back of the base. For high speed, move the selector to the left; for low speed, push the selector to the right; to disengage the gears, center the selector.

Pan (7) and *tilt* (7) *handles* are detachable and interchangeable. Either one fits into a tapered keyway within each driveshaft and is secured to the driveshaft by a center knurled-head screw. Both handles measure 6-9/16-in outside diameter. A smaller handle (3-1/2-in. outside diameter) is also manufactured.

To pan 360°. High speed requires 22 turns of the handle, while low speed requires 60 turns of the handle to complete a full circle. To pan right, turn handle counterclockwise (away from the Operator); to pan left, turn handle clockwise (toward the Operator).

To tilt 42° from center. From center to maximum elevation and depression, high speed requires 2-1/4 turns of the handle, while low speed requires 15 turns. To tilt down, turn handle counterclockwise; to tilt up, turn handle clockwise.

Turning the *pan gear access knob* (8) opens the rear base door approximately 3/8 in. and disengages the pan worm gear (not shown) from the pan gear (not shown) located in the base casting. When disengaged, the geared head is set for free panning.

NOTE: On some units the factory-installed stop has been removed, permitting the door to be opened all the way.

Attached to the bottom of the base is a steel geared-head lock screw (not shown). The screw measures 2-3/4 in. in diameter by 1-1/4 in. long, with 12 threads per inch. The lock nut (not shown) that fits the screw and clamps the geared head to the tripod (or dolly) is constructed with "ears" to aid in loosening the nut from the screw.

9.4d Maintenance

The manufacturer recommends:

All gears (pan, tilt, worm, helical) should be treated with an EP 90 (extreme pressure, 90 weight) grease which has a "sticky" additive in it.

The steel rails (upper and lower) should be wiped with oil containing a rust-inhibiting agent.

All threaded parts (screws, nuts, locks) should be coated with a light grease.

Surface rust should be removed with crocus cloth.

9.4e Miscellaneous

1. The Worrall Geared Head was originally designed for use with the BNC Mitchell camera but can be used with any camera and/or blimp.

2. Most camera *blimps* require a riser in order to clear the blimp lens-access door from the geared-head upper rails.

3. Most nonblimped cameras require a riser in order to accommodate the matte-box rods and/or a follow-focus attachment which extends below the camera base.

4. If damage or loss occurs in the field, the screw/nut chart (Table 9-3) may expedite repair.

TABLE 9-3

WORRALL SCREW/NUT TABLE

Item	Type Screwhead	Thread and Length	Hex Wrench Size
Adjustable Side Stops	Socket Hd. Cap Screws	8-32 x 5/8"	9/64
Side-Bracket Screws	Fillister	10-32 x 1/2"	—
Bracket Stops	Socket Hd. Cap Screws	1/4-20 x 3/16"	3/16
Differential-Roller-Shaft Screws	3/8" Diameter Special	3-48 x 3/16"	—
Adjustable-Rail Screws	Socket Hd. Cap	1/4-20 x 7/8"	3/16
Handle Center Screw	Special GH-96	8-32	—
Tripod Lock Nut	3-5/8" o.d.; 2-3/4" i.d.; 12 thds per inch		

5. If the camera lockdown screw fails to secure the camera tightly to the plate, a few strips of camera tape placed across the top of the cradle will act as an anchor and eliminate any slippage of the camera on the cradle.

9.4f Weight. 67 lb.

9.5 THE RISER

A *riser* (also called a *bridge plate*—see Fig. 9-4) is necessary when (1) a follow-focus attachment (which extends below the camera base) is mounted to the camera, or (2) when a blimped camera is mounted on a geared head (in order to clear the lens door from the upper rails). (See Sec. 9.4e, no. 2 and no. 3.) It is made of two metal plates separated by four 3-in. spacers.

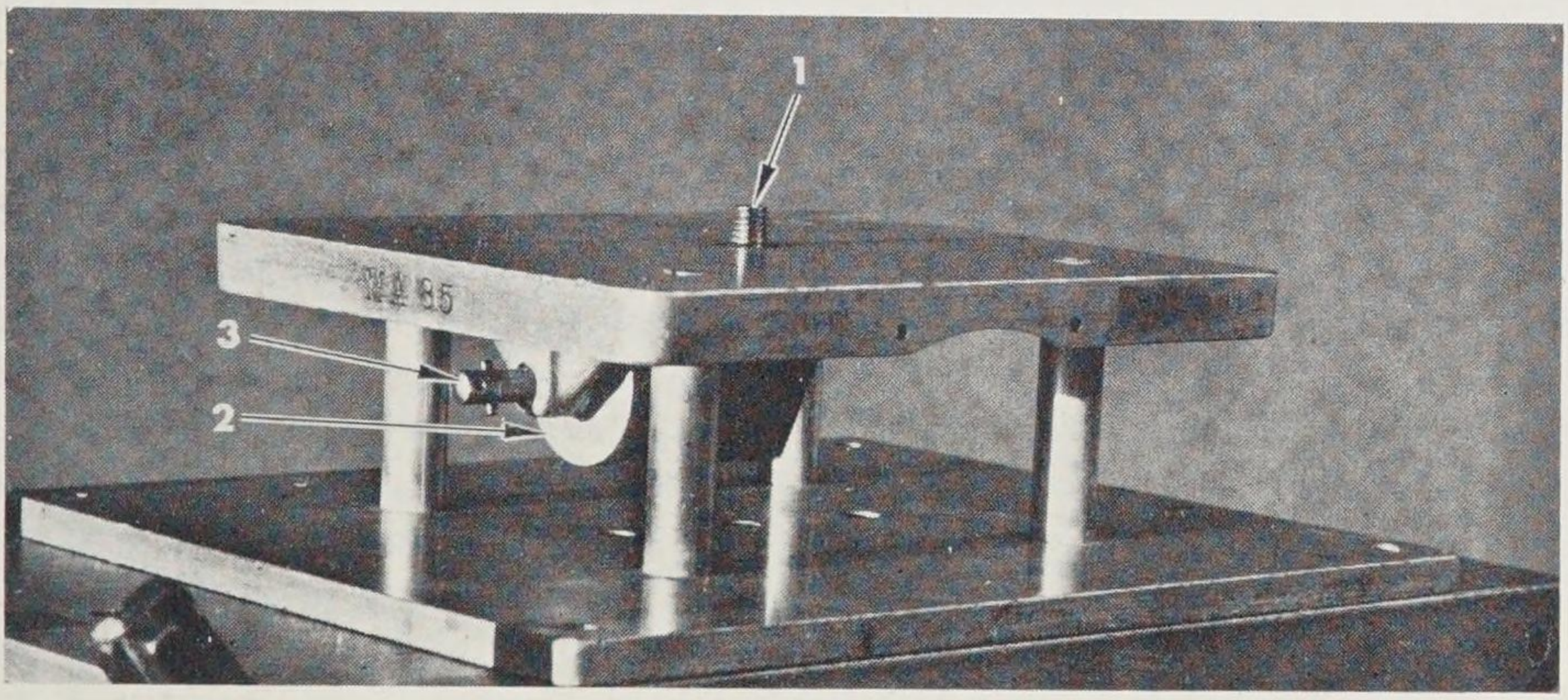


Fig. 9-4. Riser

1. Camera lockdown screw
2. Lockdown knob
3. Taper pin

Bottom plate. Fitted with a series of ⅜″-16 tapped holes to allow for placement choice on a geared head.

Top plate. Fitted with a ⅜″-16 lockdown screw connected by a pair of helical gears to a knurled lockdown knob on a shaft. The shaft is also fitted with a taper pin to accommodate a keyed hand crank to secure the lockdown screw tightly. The pin and knob always face forward when the riser is mounted on a geared or tripod head.

9.6 THE TILT PLATE (Fig. 9-5)

The *tilt plate* is necessary when a greater degree of tilt is desired than a tripod or geared head can provide. It is the same as a *riser* (see Sec. 9.5), except that the top plate is hinged at the front and vertically adjustable up to 90°.

Bottom plate. Fitted with a series of ⅜″-16 tapped holes to allow for placement choice on the geared head.

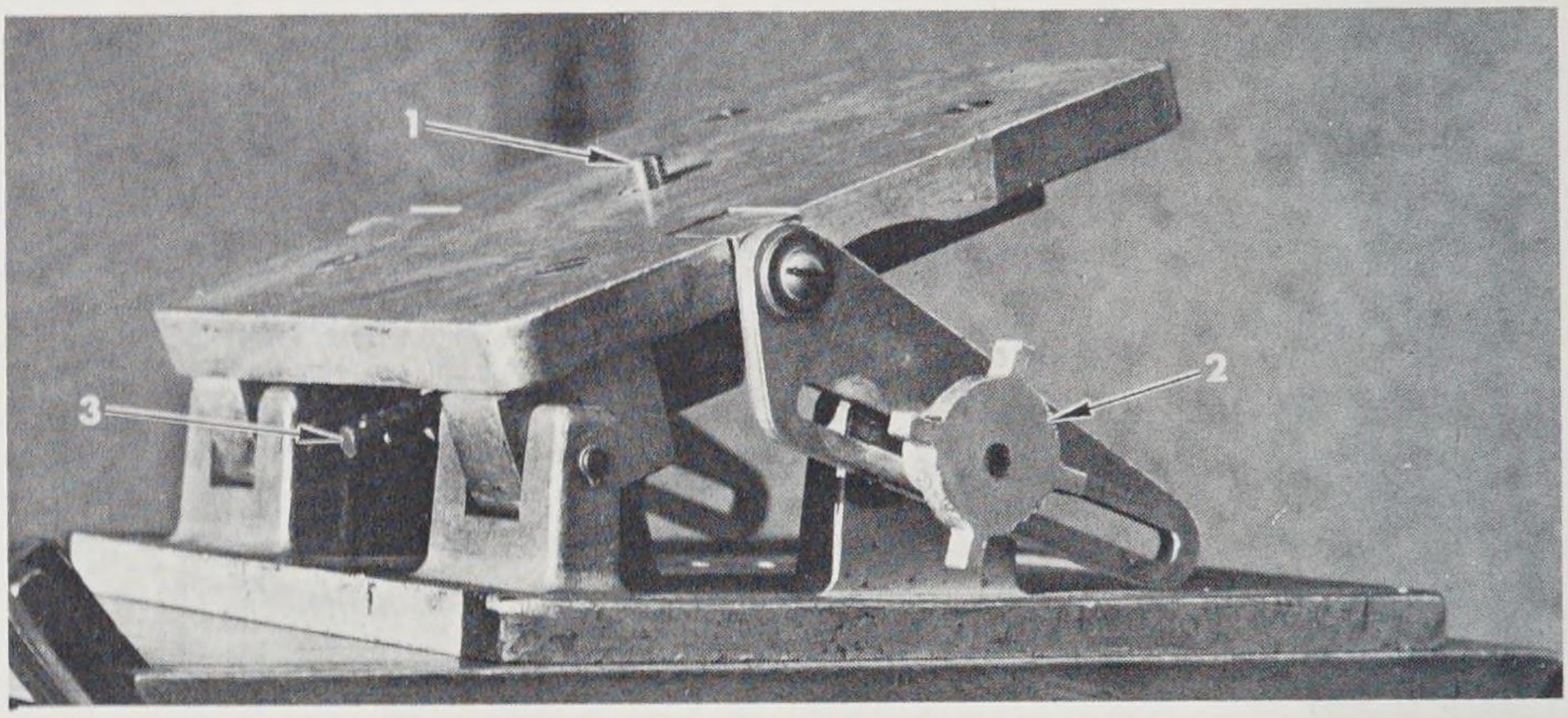


Fig. 9-5. Tilt plate (vertical adjustable screw in bottom plate not visible).

1. Camera lockdown screw
2. Pressure lock knob
3. Taper pin

Top plate. Fitted with a ⅜"-16 lockdown screw, connected by a pair of helical gears between the plates to a knurled lockdown knob on a shaft. The shaft is also fitted with a taper pin to accommodate a keyed hand crank to secure the lockdown screw tightly. The pin and knob always face forward when the tilt plate is mounted on a geared or tripod head.

A vertical, adjustable screw in the bottom plate is used to level the top plate when the top plate is in the horizontal position. (Absolute level insures greater accuracy of degree of tilt when wedge is lifted.)

NOTE: Some tilt-plate designs utilize a worm gear and hand crank to lift the rear of the top plate up and forward. Other designs utilize adjustable arms (fitted with center restricted slots) attached to the bottom plate at both sides. Two pressure lock knobs insert through the restricted slots into the top plate. The knobs are loosened to free the plate, secured when the rear of the top plate is manually lifted up and forward to the desired tilt position.

CHAPTER 10

Arriflex Cameras, Magazines, Blimps, and Accessories

10.1 ARRIFLEX 35 IIC CAMERA (Figs. 10-1, 10-2)

NOTE: All directions are from the Operator's point of view.

10.1a Base

Bottom rear fitted with ⅜"-16 tapped hole to accommodate tripod lockdown screw. Bottom front is fitted with a guide stud which extends 3/8 in. below the base.

10.1b Hi-hat

This unit is required when using the camera on a flat tripod head.

To mount camera: Insert camera motor through top of hi-hat. Insert forward guide stud into stud groove at hi-hat front. Secure ⅜"-16 lockdown screw to camera.

10.1c Motors

Mount vertically to base of camera; in this position motors serve as a handgrip.

Motors house the following: rheostat, on a variable-speed motor, or fuse, on a governor-controlled (constant-speed) motor; an ON/OFF switch; a short-burst button; a FWD/REV toggle switch.

Variable-speed motor: Left pin of socket is "+," and must be aligned with the "+" mark on the female cable plug.

To adjust speed: Rotate rheostat cap (at bottom of motor below the power-cable socket) clockwise for fast, counterclockwise for slow. Motor speed marks scribed on rheostat are for reference only. Correct frame-per-second speed is obtained by observing tachometer (at right rear of camera).

To reverse: Turn small toggle switch (located above the power-cable socket) from "V" to "R."

Governor-controlled (constant-speed) motor: To insure that polarity will not be accidentally reversed causing damage to the motor, the power-cable socket is fitted with one large diameter socket pin (+) and one small diameter socket pin (—) to prevent incorrect insertion of the power line. A *buss fuse* for the motor is 3/4 in. long and rated at four amperes; it is located beneath the cap at the base of the motor.

To mount either motor: Invert camera, place ON/OFF toggle switch on same side as door. Align center transfer gear with motor-drive gear and lower onto base of camera. Secure to base with four screws.

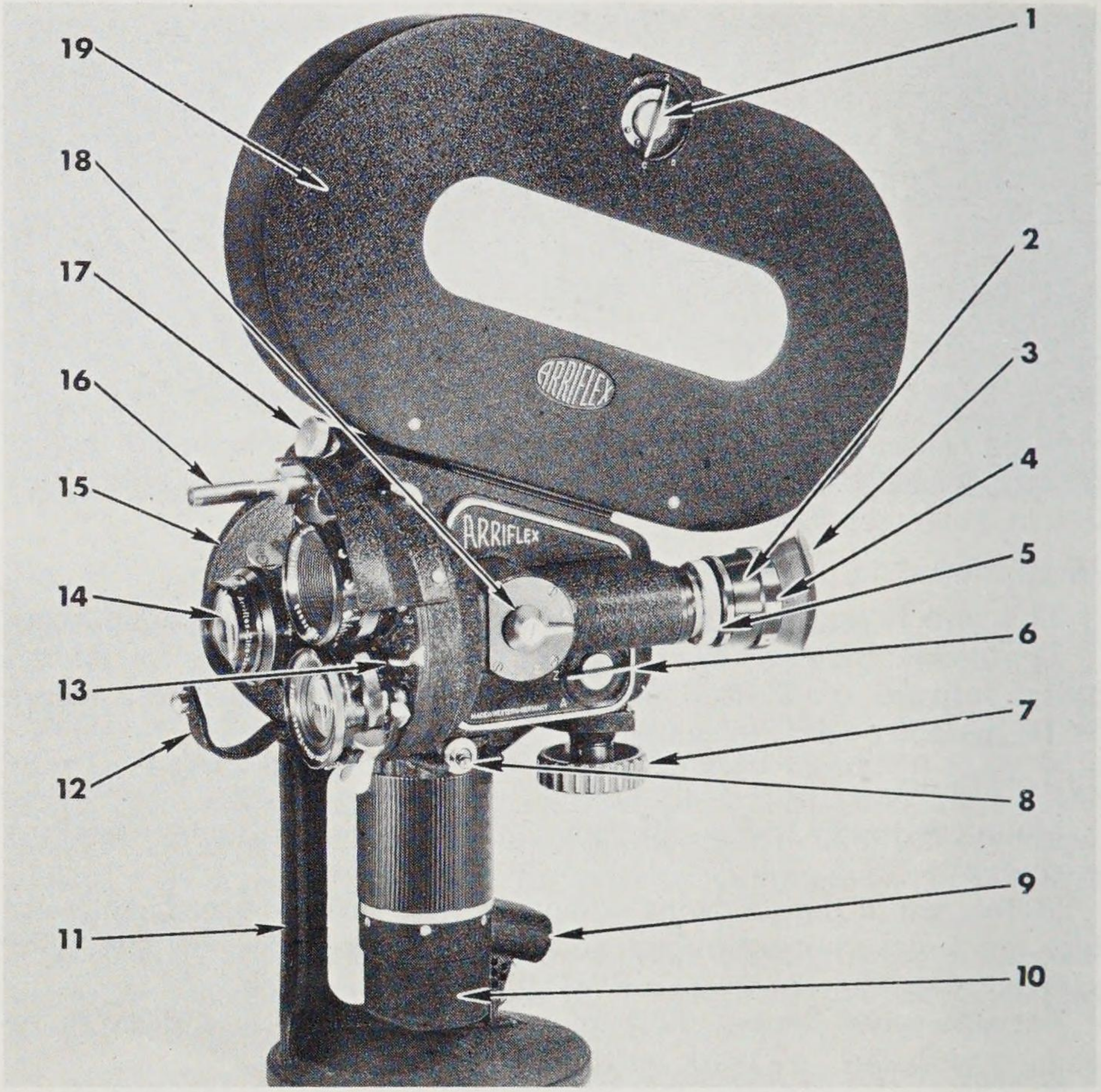


Fig. 10-1. Arriflex IIC (left front view with matte box removed). Governor-controlled (constant-speed) motor. Courtesy of Arnold & Richter K.G.

1. Magazine cover latch
2. Eyepiece
3. Eyecup
4. Eyepiece focusing ring
5. Eyepiece coupling nut
6. Door lock
7. Camera lockdown screw of adapter
8. ON/OFF toggle switch
9. Power-cable socket
10. Governor-controlled (constant-speed) motor
11. Hi-hat adapter
12. Sunshade bracket
13. Turret grip
14. Taking lens
15. Contour grip
16. Sunshade mount
17. Magazine lock knob
18. Viewfinder closing lever
19. 400-ft magazine

To remove: Invert camera, loosen four screws. Lift motor up slowly until clear of the gears.

CAUTION: The center (fiber) transfer gear may lift with the motor. If it does, replace the gear and position it so that the teeth of the transfer gear work *against* the teeth of the camera drive gear.

NOTE: A minimum of 12 volts is required to run the camera with a 400-ft. load of 24 fps. It requires 16 volts or more to run the camera faster than 24 fps.

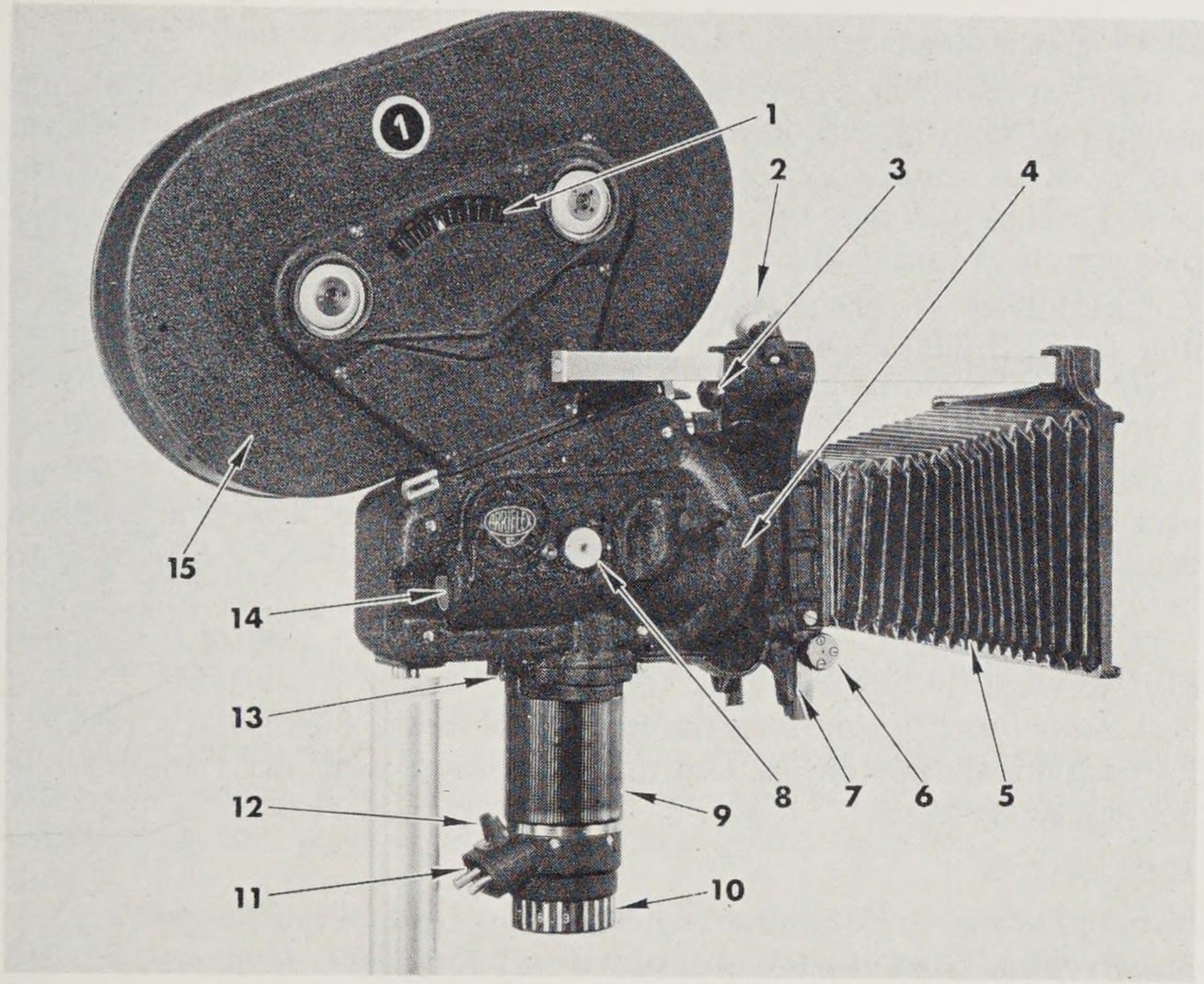


Fig. 10-2. Arriflex IIC (right-rear view with matte box). Variable-speed motor. Courtesy of Arnold & Richter K .G.

1. Footage counter
2. Bellows boom locking screw
3. Sunshade pressure clamp
4. Contour grip
5. Bellows/matte box
6. Filter adjust knob
7. Adjustable filter holder
8. Inching knob
9. Variable-speed motor
10. Rheostat cap
11. Power-cable socket
12. FWD/REV switch
13. Short-burst button
14. Tachometer
15. 400-ft magazine

The following motors are available for the Arriflex 35 IIC:

Variable-speed motor: 16V DC, 24–28V DC, 32V DC (slow motion; maximum 80 fps).

Governor-controlled (constant-speed) motor: 16V DC (24 fps), 16V DC (25 fps), 24V DC (24 fps), 24V DC (25 fps).

Synchronous motor: 110V AC 60 Hz (24 fps), 110V AC 50 Hz (25 fps), 220V AC 50 Hz (25 fps) (single and/or 3-phase).

Animation/Time Lapse Motor: 110V AC 60 Hz (stepped-down and rectified to 24V DC), 110V AC 50 Hz (stepped-down and rectified to 24V DC).

10.1d Power line

Input to camera: Power-cable socket is located at base of motor: above the rheostat cap on a variable-speed motor and above the fuse cap on a governor-controlled (constant-speed) motor. The split recessed socket pins may be separated slightly to secure the female cable plug snugly onto the pins.

> CAUTION: The metal pins are fragile and will break if handled roughly. If one side of a split pin *is* broken off, a match stick inserted into the female plug, in the space the broken pin would ordinarily occupy, will act as a wedge and provide a good electrical contact.

Cable: Insert the male end of the cable into the battery ("+" on plug aligns with red "+" on battery). On some cables a pressure catch near the male end can be attached to a clip on the battery to hold the male plug securely to the power source.

ON/OFF toggle switch is located at the top left side of the motor. Push forward for ON, rearward for OFF.

A short-burst button is at the top of the motor facing the Operator; its position allows him to depress the button with his thumb while holding the camera.

10.1e Turret

Three-position. *No* divergence of ports as with 16mm cameras.

To rotate: Grasp turret grip opposite taking lens. Depress (or lift) until desired lens rotates into position nearest the contour grip at the right side. Turret snaps into place.

> NOTE: Turret grips have indented data marks which are visible to the Operator and help him to determine which lens is in the "taking" position, i.e., the widest-angle lens, one dot; the normal lens, two dots; and the telephoto lens, three dots. Each lens should be mounted opposite the data mark to which it corresponds.

10.1f Lenses

To mount on turret: Rotate lens barrel until channel in the mount aligns with the infinity mark on the lens. Grasp lens by its knurled footage ring. Squeeze locking levers at each side of the lens port on the turret and insert the lens into the port with the follow-focus grips ("wings") *up*. Slide the channel at the rear of the mount over the guide key inside the lens port. Release the locking levers. Gently tug at lens to make certain the levers have gripped the channel at the rear of the lens mount.

> NOTE: Lenses should correspond as closely as possible to the data marks on the turret grips.

To remove: Rotate follow-focus grips *up*. Grasp knurled footage ring. Squeeze locking levers at each side of lens port and gently pull lens away.

> CAUTION: When using less than three lenses, always plug the empty port(s) to avoid a light leak to the aperture.

NOTE: 16mm and 35mm Arriflex lenses are interchangeable with the following exceptions: 5.7mm, 10mm, 11.5mm, 16mm, and 25mm. These will *not* "cover" a 35mm aperture. The only wide-angle lenses that *will* "cover" a 35mm aperture are: 9.8mm, 14.5mm, 18.5mm retrofocus, and the 28mm *made for 35mm cameras.*

10.1g Viewfinder: Reflex. Image magnified 6-1/2 ×.

To align reflex mirror for viewing: Rotate knurled inching knob at right side of camera (located at rear of contour thumb grip) until shutter is cleared.

NOTE: Cut two pieces of masking tape into "pointers" and place one on the inching knob and the other on the camera. Alignment of the two points indicates that the shutter is cleared from the mirror. This allows an Assistant to align the points immediately upon the completion of a shot, and the Operator does not have to "grope" for the inching knob.

To detach eyepiece: Rotate knurled eyepiece coupling nut on finder clockwise and pull eyepiece from keyed slots.

Hinged metal cap (located inside the eyecup): Closes viewing system. This cap must be closed when Operator's eye is not covering the eyepiece so that stray light cannot strike mirror and "kick back" onto film.

Light trap: Another means of closing the finder and avoiding "kick-back." *Newer models* (shown): Push two-position *viewfinder closing lever* on front side of finder *down* to close; push *up* to open. ["Z" (zu) = closed; "A" (auf) = open.] *Older models:* Lever at bottom of finder pushes forward to close; back to open.

To focus: Newer models (shown): Rotate narrow scalloped ring on eyepiece clockwise to the word "lose" (loose). Rotate large scalloped ring (nearest eyecup) to focus on the groundglass. When focus is set, turn the narrow ring counterclockwise to "fest" (tight). *Older models:* Loosen small lever on eyepiece. Rotate barrel to scribe numbered with "+" or "—" diopter settings. Focus on groundglass. When focus is set, lock small lever.

Groundglass: Newer models: To remove:

1. Lift out taking lens. 2. Turn locking screw (on groundglass frame) counterclockwise. 3. With fingers, or paper clip hook, pull groundglass straight out.

NOTE: The groundglass inserts only one way—with the smooth surface of the groundglass toward the eyepiece. *Older models:* The internal groundglass is fixed, and removal of the gate is necessary for access. The smooth surface is toward the eyepiece.

CAUTION: The manufacturer recommends only a competent technician change the groundglass on older models, as replacement of the gate requires accurate adjustments.

10.1h Sunshade/matte box

Two types available—fixed and bellows. Both are detachable from the camera.

To mount either type: Fit the sunshade pressure clamp over the sunshade mount (above and right of turret), making certain that the registration hole at the bottom of the sunshade fits over the lower sunshade bracket which is below and forward of the handgrip. Secure the knurled screw of the pressure clamp clockwise.

Bellows type (shown): Adjustable. Bellows slides in/out on boom. To extend matte box, loosen knurled locking screw on boom above the matte box (fully extended bellows will protect a 50mm lens).

Masks: Both fixed- and bellows-type matte boxes accept sliding masks (for lenses longer than 50mm) in a slot in the front of the sunshade.

10.1i Filters

Fixed matte box/sunshade-type filter holder (not shown) accepts one 3 × 3 in. filter.

To insert: Pull retaining spring pin at left of filter housing. Flip (hinged) top door of filter holder open, push filter down until seated. Close door and release retaining spring.

To remove: Pull retaining spring pin, open holder door, push filter *up* from the bottom.

Bellows-type adjustable filter holder (shown) accepts one 3 × 3 in. glass filter, or one 3 × 4 in. glass filter.

To insert: Pull retaining spring pin at left of filter housing, open top door, push filter down until it rests on bottom of holder bracket. Rotate knurled filter-adjust-knob below filter holder counterclockwise to lower the holder into the matte box. Close the top door, release the retaining spring. Adjust filter to desired position.

10.1j Door: Dog-locked.

To remove: Rotate recessed door lock (below finder) counterclockwise, from "Z" (zu = closed) to "A" (auf = open).

CAUTION: Door is not hinged.

To close: Turn door lock to "A." Insert back of door into camera door recess, swing front of door flush with camera. Rotate lock to "Z." Grasp finder and pull gently to ascertain door is properly secured to the camera.

10.1k Magazines: 400-ft (shown) and 200-ft.

To mount:

1. Rotate knurled lock knob above turret clockwise until spring action frees the lock knob. 2. Remove cover plate from top of camera. Make certain that gears of magazine are at same side as camera gears. Insert film into camera cavity. 3. Seat rear male dovetail into rear female dovetail on camera housing, then lower front male dovetail into housing. Rotate inching knob to mesh gears properly. 4. Depress knurled magazine lock knob and rotate counterclockwise to lock.

To remove: Unthread camera. Rotate magazine lock knob clockwise, and lift magazine away.

10.1l Threading (Fig. 10-3)

1. Rotate inching knob until single pulldown claw is in center of pressure-pad slot, and withdrawn from the gate. 2. With the pressure plate *closed*, mount magazine, allowing loop to fill camera interior. Pull plate catch with forefinger, swing plate open with thumb. 3. Pull film around pressure plate and insert it into the gate. With middle and index fingers, conform the film to the upper loop guideline. 4. Rotate inching knob clockwise until pulldown claw moves up and engages a perforation. A proper size loop contains 15 perforations between the mouth of the magazine and the claw. 5. Close pressure plate and rotate the inching knob to check engagement of the claw. If satisfactory, depress the short-burst button and observe the action of the film. If satisfactory, close the camera door.

10.1m Buckle-trip

Installed on some, but not all, models. Located above the lower

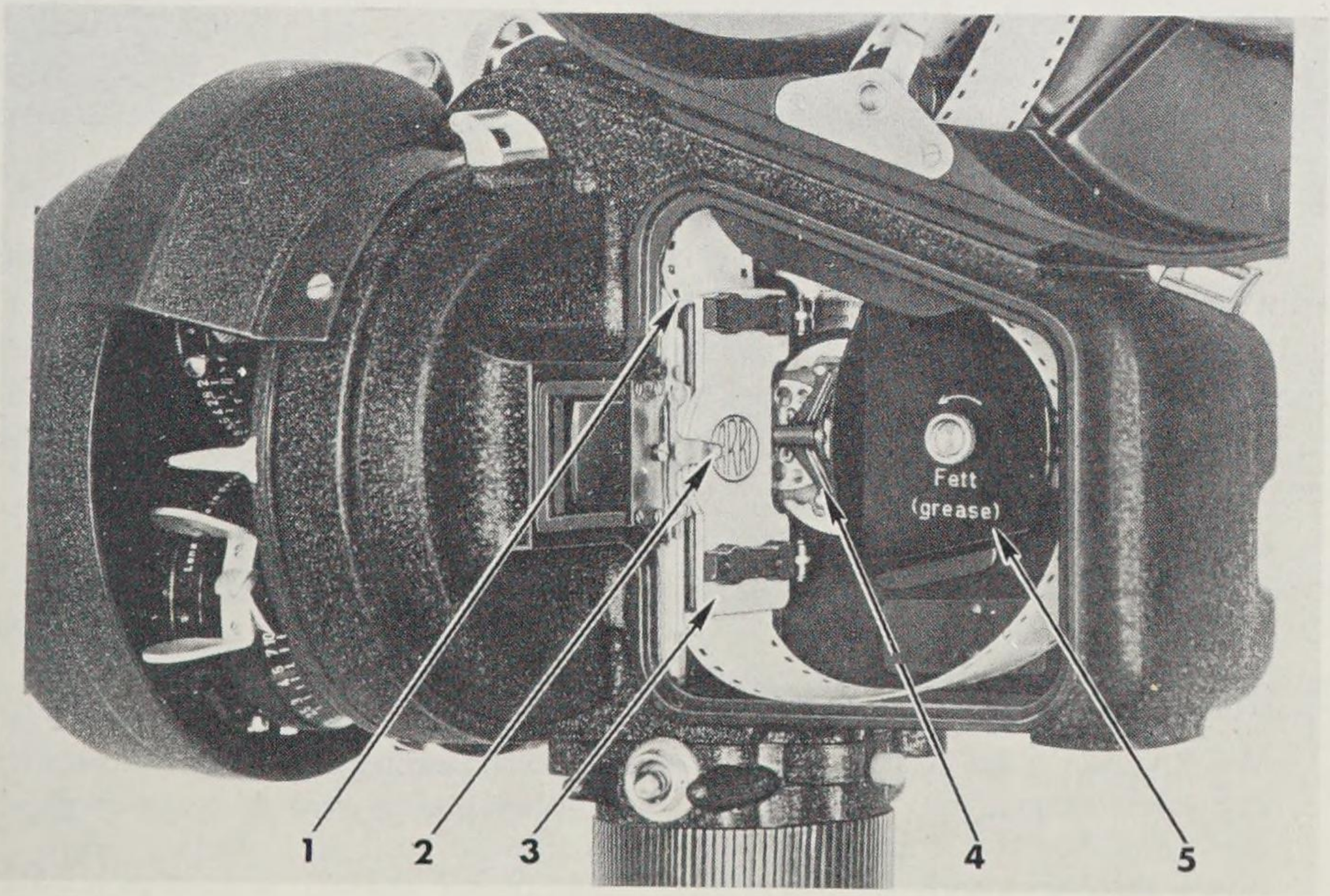


Fig. 10-3. Arriflex IIC threading detail. Courtesy of Arnold & Richter K. G.

1. 15-perforation loop
2. Plate catch
3. Pressure plate
4. Pulldown claw
5. Gear cover

guide track. A rubber tubing on an arm cuts out power when pulled up by a short lower loop.

To reset: Push arm down gently.

10.1n Footage and frame counter: None on camera (see Sec. 10.2h under "Magazines").

10.1o Tachometer

At back of camera. Registers speeds from 0 to 50 fps, in increments of one frame per second.

CAUTION: Camera is not governor controlled. A variable-speed motor *can and will* run faster than 50 fps. It cannot be assumed that by arbitrarily turning the rheostat so that the needle registers 50, the camera is running at 50 fps. Incorrect exposure can result if the camera speed is not deliberately and conscientiously set by the cameraman.

10.1p Shutter: Nonadjustable. Equivalent to 180°.

NOTE: Models I and IIA have a 120° shutter. Models IIB and IIC have a 180° shutter. Models IIBV and IICV (variable-shutter model) have a 165° shutter.

Variable-shutter camera (Model IICV—not shown): Zero to 165°. Adjustable in increments of 15 degrees.

To read variable shutter: Align the color at the edge of the mirror reflex shutter with its corresponding scale: Black edge = inner scale (closest to the handgrip). Red edge = outer scale (closest to the turret center knob).

To change shutter opening:

1. Remove taking lens to view shutter increments. 2. Turn knurled shutter adjusting knob (not shown) (below the thumb grip on the camera right side), in the direction of the arrow, to the limit of its rotation. *Then* press *in*, to arrest shutter blade. 3. Rotate knurled inching knob (rear of contour thumb grip) until the shutter clicks into the desired opening.

CAUTION: The shutter *must* be set into a scribed increment. If it is set *between* increments, it will drift while running, thereby rendering an incorrect exposure.

4. Release inching knob and spring-loaded shutter-adjusting knob.

WARNING: The shutter should be checked before and after mounting each magazine. It is possible, if the end of a roll goes through the gate, for the crimped end of the film to pull the shutter edge down and/or closed.

10.1q Lubrication (Fig. 10-4)

Manufacturer recommends lubricating the following parts every 15,000–20,000 ft. Unscrew knurled knob and remove gear cover marked "Fett (grease)" from interior of camera.

Grease: Claw cam. Intermediate gear stud (hole at right of loop indicator plate).

Oil: Trunnion (two holes). Pivot block. (Six to eight drops each.)

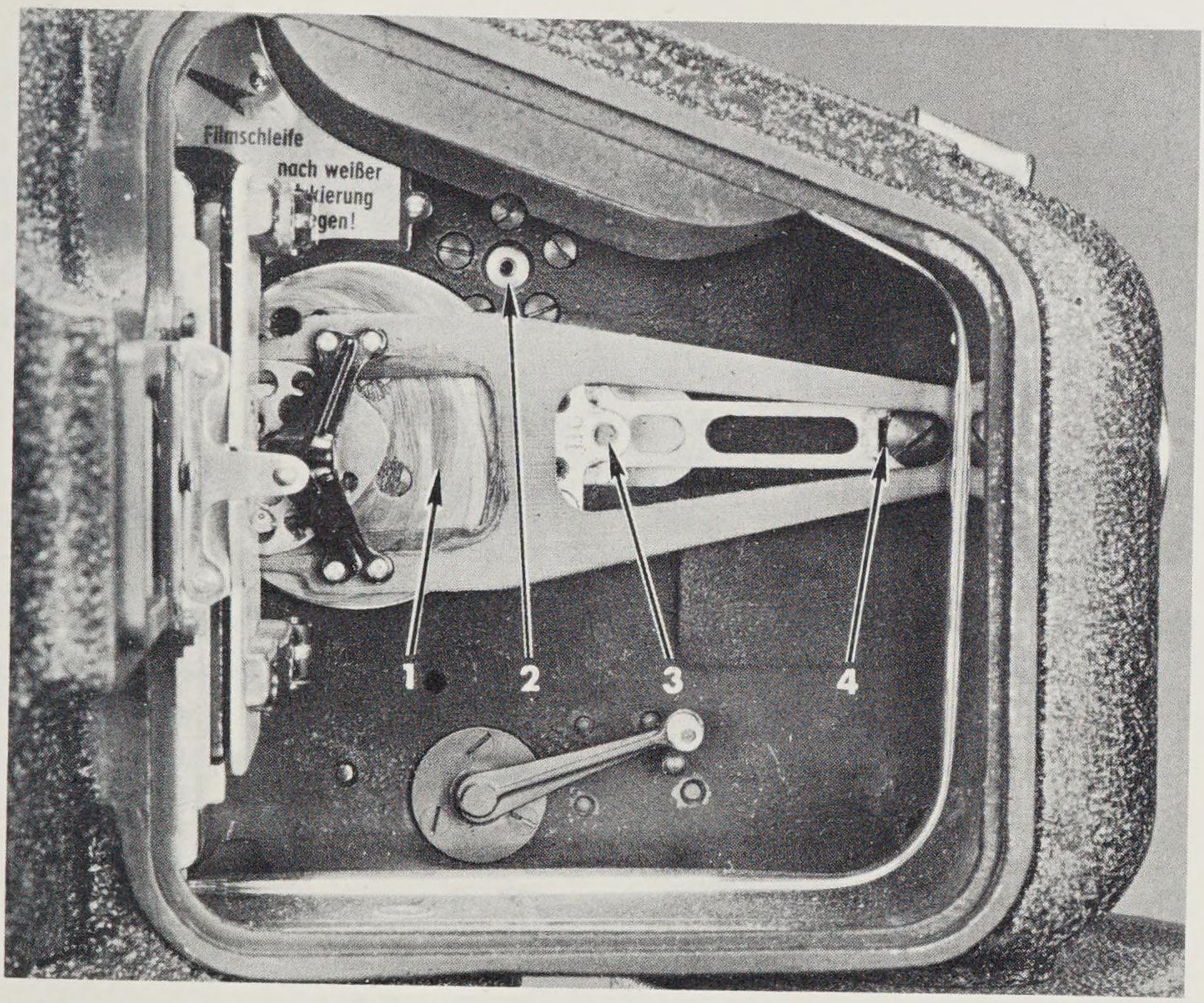


Fig. 10-4. Arriflex IIC lubrication. Courtesy of Arnold & Richter K. G.

1. Claw cam (grease)
2. Intermediate gear stud (grease)
3. Trunnion (oil)
4. Pivot block (oil)

CAUTION: Do not oil the gears! Manufacturer warns that oiling too frequently and/or excessive oil can damage the camera mechanism.

10.1r Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Open plate catch and check the plate and pad for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

10.1s Weight: (with 400-ft load) 16-1/2 lb.

10.1t Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Battery connections loose; battery dead; buckle-trip not reset
Intermittent starting and stopping	Slotted power-line prongs (in battery or camera) squeezed together, making poor

Trouble	*Probable Cause*
	contact; lugs on battery cell loose; broken connection in power line
Torn perforations; ripped film	Improper threading
Door will not close	Door lock not on "A" (open); chip or dirt in door recess
Viewing system blacked out	Shutter closed; eyepiece cap closed; lens stopped down past *f*/22; lens cap on
Lens will not focus	Lens not seated; camera too close for minimum focus distance of lens; elements damaged
Cut-in on groundglass (wide-angle lens)	Viewing mirror "sees" aperture of lens but camera aperture does not—no problem if turret is properly seated
Cut-in on groundglass (normal lens)	Turret not seated; matte box extended
Lens will not enter port	Guide key inside turret bent up or down, therefore will not enter lens channel
Film does not take up in magazine	Magazine take-up spindle loose; film loose on take-up core

10.2 ARRIFLEX 35mm IIC MAGAZINES (Fig. 10-5)

10.2a Type: Displacement.

10.2b Capacity: 200-ft (shown) and 400-ft (shown).

10.2c Lid: One. Lug- and dog-locked.

To open: Depress safety spring in lid recess, rotate lock bar counterclockwise (from "C" to "O"). Lift.

10.2d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

10.2e Take-up

Right side. Film winds on spindle clockwise, emulsion always in.

10.2f Loading

1. Remove lid; swing footage-counter/roller-guide arm to right, and lock the arm in the pressure catch next to the take-up spindle. 2. In darkness, remove film roll from can and bag. Pull film off roll clockwise. Insert film end into left side of magazine throat, slowly rotating gear at bottom counterclockwise with right thumb until gear in throat engages film perforation; thread at least 6 in. of film through.

NOTE: To expedite engagement of film and magazine gear, cut the film so as to bisect the perforations.

(3) Place film roll on feed spindle. Rotate knurled feed-spindle wheel until the spindle key spring engages the core keyway. 4. Release footage-counter/roller-guide arm making certain that flanges ride the film perforations. 5. Pull film end around front of magazine until cut perforations touch marking rib (raised metal bar) on outside of magazine. 6. Hold gear; bring film end back and insert end into right-hand channel of magazine throat. Rotate gear until perforation engages gear and film moves into magazine.

WARNING: Do not allow excess film to exit feed side while trying to engage perforation and take-up gear.

NOTE: It is important to maintain proper loop size: 54 perforations for both the 400-ft and 200-ft magazines.

400-ft magazine: Insert film end into collapsible take-up core; move clamp inward to secure film.

200-ft magazine: Fold back 3–4 in. of film on itself and insert the double thickness into the core slot; wind film on core clockwise and fit core onto spindle. Rotate knurled take-up spindle wheel until spindle key spring engages the core keyway.

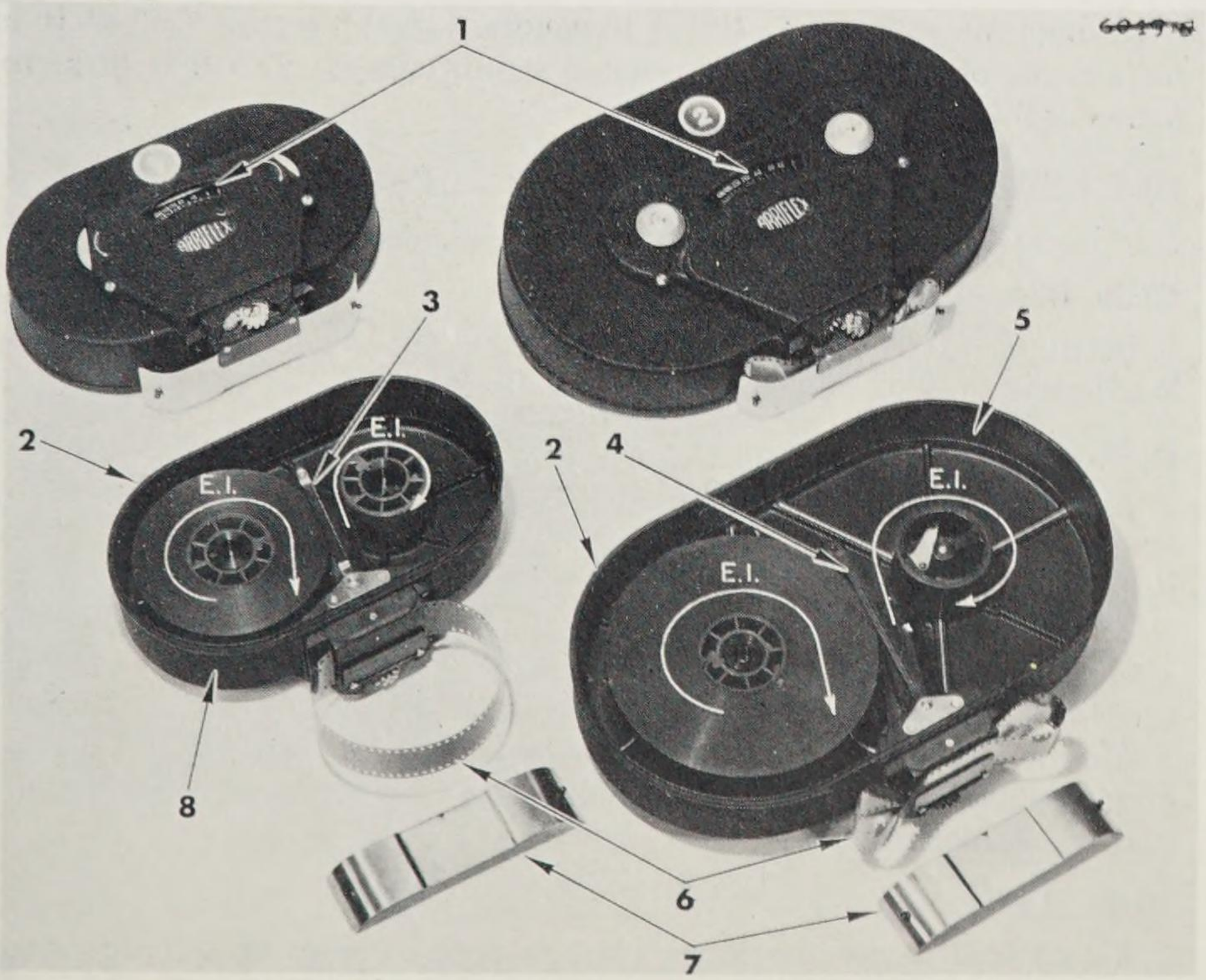


Fig. 10-5. Arriflex 35mm magazine. Courtesy of Arnold & Richter K. G

1. Subtractive footage counter
2. Marking rib
3. Footage counter/roller-guide arm 200 ft
4. Footage counter/roller-guide arm 400 ft
5. 400-ft magazine
6. 54-perforation loop
7. Loop guards
8. 200-ft magazine

To replace lid: While holding lid at 45° angle, insert lugs (at bottom) into mating slots in magazine; lower the lid to a secure fit; rotate lock bar clockwise from "O" to "C" until safety spring snaps up. Pull up on lid, and run fingernails around its edge to determine that lid is secure.

To take out film slack: Rotate spindle wheels at back of magazine; take-up rotates counterclockwise; feed rotates clockwise.

Film-loop guard: Depress film loop against magazine mouth. Slide loop guard (with notch inward) over film and under retaining plate.

10.2g Unloading: In darkness, remove lid.

400-ft magazine: Disengage take-up clamp (push outward) on magazine that has a collapsible core; place index finger in core space, thumb on edge of roll; turn magazine over and remove the film. Place exposed roll in bag and can.

200-ft magazine: Place index finger in center of core, thumb on edge of roll; turn magazine over and remove the film. Place exposed roll in bag and can.

10.2h Footage counter

At back of magazine. 400-ft magazine is subtractive: 500–0 ft in increments of 20 ft. 200-ft magazine is subtractive: 220–0 ft in increments of 20 ft.

10.3 ARRIFLEX 35mm MODEL 400 BLIMP (Figs. 10-6, 10-7)

NOTE: All directions are from the Operator's point of view.

10.3a Base

Bottom is fitted with two ⅜"-16 tapped holes to accommodate tripod lockdown screw.

10.3b Camera preparation

Eyepiece: Remove from camera. Attach viewfinder extension tube to eyepiece and insert the unit into the blimp extension tube access hole. Rotate lock lever on blimp clockwise to secure the tube.

Door: Remove the regular camera door with its viewfinder (see Fig. 10-1) and replace it with the straight tube door—a camera-blimp accessory (not shown).

Motor: Remove either the variable-speed or the governor-controlled (constant-speed) motor and replace with the AC-synchronous-motor plate (see Sec. 10.4).

10.3c Access

To camera: Raise the lower camera access clamp on left side door, then lower the door 90°.

To lenses: Rotate lens access lever clockwise at left front of matte-box glass door; swing door open.

To magazine: Lower the upper magazine access clamp at left side of blimp, then lift the magazine access hood *up*.

10.3d Camera insertion

1. Push out the pin in the rear focus knob at back of blimp (below eyepiece), then pull knob toward Operator. 2. Reach inside blimp and slide the rear focus extension rod toward back of blimp. Remove the rod. 3. Loosen the two knurled screws and remove the two base lock-down nuts from internal triangle camera-mounting plate accessory (see Fig. 10-8). 4. Insert the camera mounted on the plate (without magazine) into blimp. The locating stud on the right side of the base is inserted into a mating hole of the camera-mounting plate. 5. Reinsert the two base lockdown nuts and secure the synchronous-motor plate to the camera-mounting plate. 6. Replace the focus extension rod: (a) insert the rod pin into the mating focus-knob groove first, then (b) fit the flange on the rod to the three studs in the front gear. 7. Push rear focus knob forward. Insert pin into rear focus knob to secure. 8. Mount camera magazine through the magazine access hood.

10.3e Power line

External

Power-supply plug: Recessed six-pin male Tuchel plug is inserted into female receptacle at right rear of blimp.

ON/OFF switch: Single-pole switch at right rear of blimp.

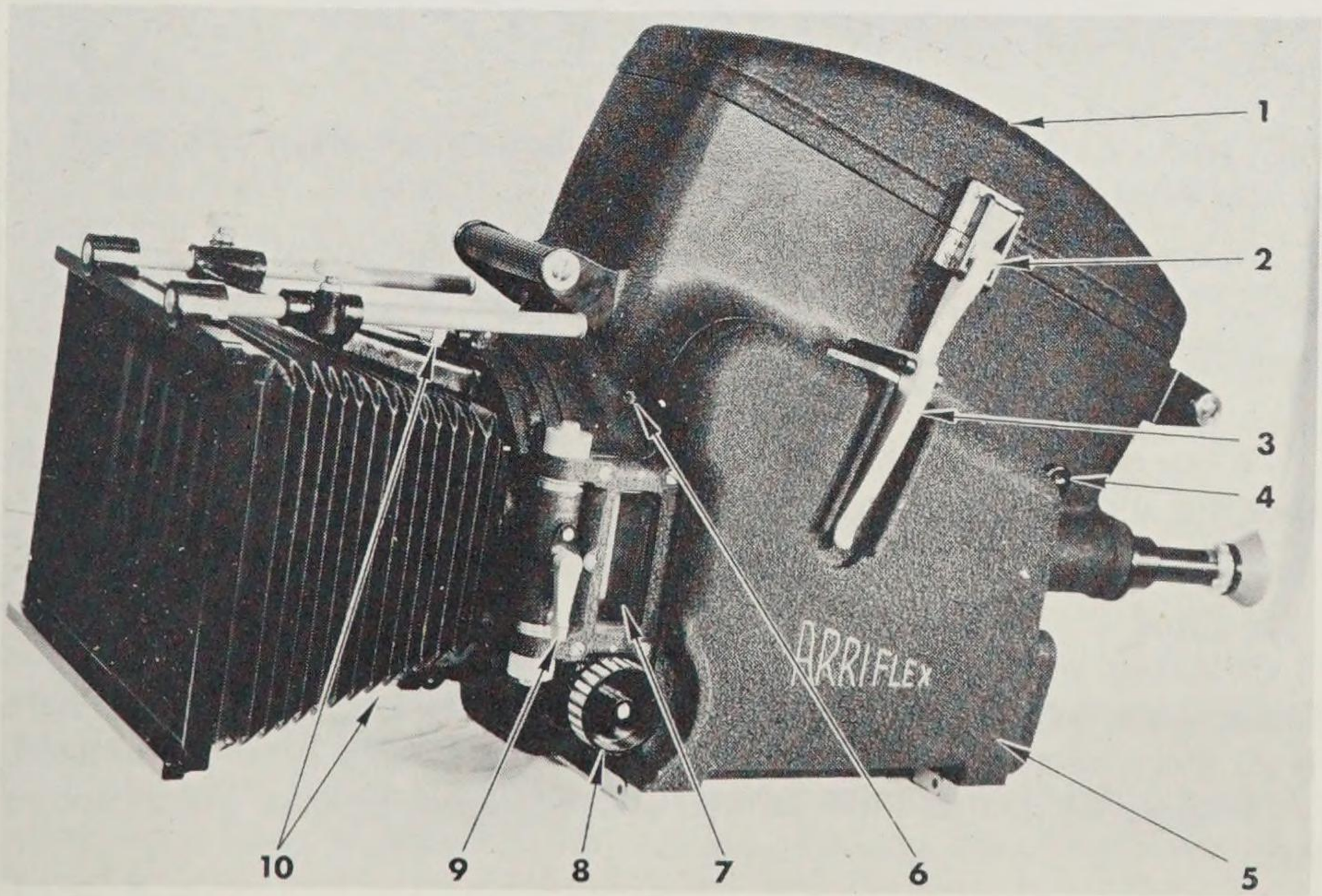


Fig. 10-6. Arriflex 35mm Model 400 blimp (front view). Courtesy of Arnold & Richter K. G.

1. Magazine hood
2. Magazine access clamp
3. Camera access clamp
4. Running light
5. Blimp door
6. Internal light button
7. Marking strip port
8. Focus knob
9. Lens access lever
10. Sunshade lock nuts

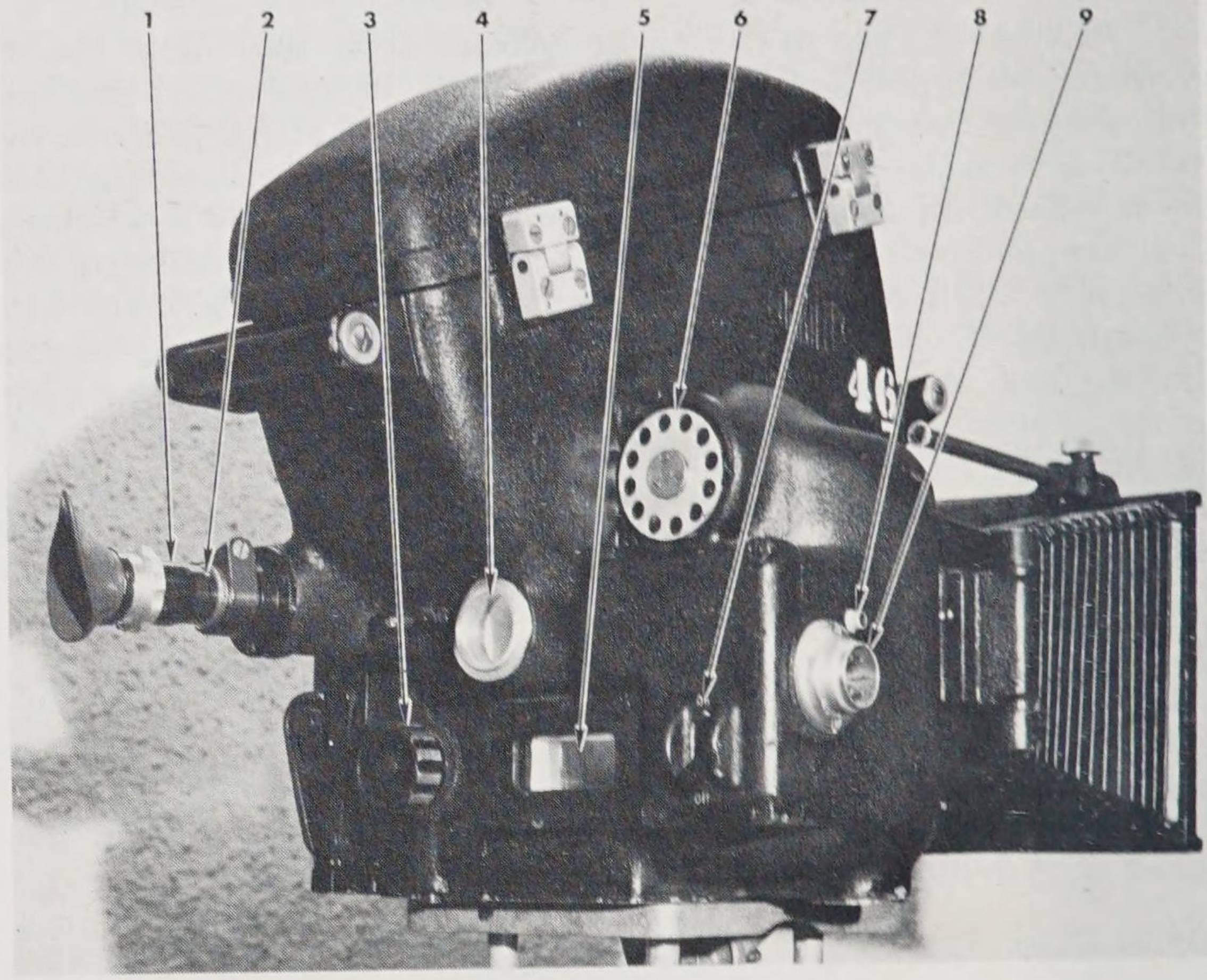


Fig. 10-7. Arriflex 35mm Model 400 blimp (rear view). Courtesy of Arnold & Richter K. G.

1. Extension tube
2. Access hole
3. Rear focus knob
4. Tachometer port
5. Footage counter port
6. Telephone-dial inching knob
7. ON/OFF switch
8. Sync-pulse outlet (optional)
9. Power supply plug

To operate internal lights: Depress button at left front (above the aperture and footage viewing port).

NOTE: Early models do not have this feature.

Internal

Coupling for adapter cable: Three-pin plug inside blimp (above tachometer port) inserts into extension plug on camera motor. There is *no* sync-pulse outlet on the Model 400 unless it has been customized.

Running light: Red light located above eyepiece glows when camera runs.

10.3f Sunshade

To mount: Raise the upper knurled lock nut at front of lens door. Lower the bottom lock nut. Align slots at rear of sunshade housing with the lock-nut brackets. Lower the upper lock nut, raise the bottom lock nut, and secure sunshade to the lens door. Bellows moves in/out on two rods. Tighten knurled lock screw on each rod to secure.

10.3g Coupling alignment

Focus marking-strip indicator: On lens gear housing.

To insert strip:

1. Open lens access door; place the long hole of marking strip over the lower catch on lens gear housing. 2. Wrap the marking strip around lens gear housing; push the upper spring-loaded catch *up*. Place the small hole of the strip over spring-loaded catch; release.

To scribe footage marks on marking strip: Open camera access door and insert a pencil into the notch inside blimp at left of lens gear ring.

To mark blank strips: Couple lens to focus knob (see "Standard Lenses," below.) Set lens at infinity. Make infinity pencil mark (∞) on strip. Set focus at each footage indication on lens barrel and transcribe each setting to marking strip. At the bottom, write the focal lengh of the lens for which the strip has been marked. There is *no* *f*/stop scale on the marking strip. All *f*/stops are set manually.

Standard lenses:

1. Open the lens access door and set the taking lens at infinity. Rotate the lens gear in the lens access door and align the two dots (one on the gear, one in the door).

> CAUTION: Be sure that the rubber end of the spring-tension focus bracket arm on the lens gear is *up*.

2. Close and lock the lens access door. Reach through the side door and depress the rubber end of the focus bracket arm into the "wings" of the lens.

f/stop drive: None; *f*/stops must be set manually.

Focus knob: Scalloped knob at left front of blimp is coupled to the rear focus knob so that the Operator can focus.

10.3h Filters

A 3 × 3 in. glass filter inserts into a holder in the gear ring housing. The rotating spring latches secure the filter in the holder.

10.3i Viewfinder/focus tube

To align reflex mirror for viewing: Place fingertips into recess of "telephone-dial" knob at back of blimp. Depress and rotate to engage motor.

Eyepiece: Rotate narrow scalloped ring on eyepiece clockwise to the word "lose." Rotate large scalloped ring nearest eyecup to focus on groundglass; turn narrow ring counterclockwise to "fest."

Light trap: Hinged metal cap in eyepiece snaps closed to prevent stray light from striking the mirror and "kicking back" onto the film.

10.3j Ports

Vertical window at left side above the focus knob permits viewing of the marking strip. Tachometer and footage-counter ports are at back of blimp.

10.3k Weight: (less camera) 39 lb.

10.4 ARRIFLEX 110V AC SYNC MOTOR ON PLATE (Fig. 10-8)

The synchronous motor on a plate permits the use of the 35mm Arriflex with a 110V AC power source. It may be used on a standard tripod and/or within a blimp.

Bottom of plate: Fitted with ⅜″-16 tapped hole to accommodate tripod lockdown screw. Synchronous motor is permanently affixed to plate.

Gear Box in plate contains double-height transfer gear that meshes with camera drive gear.

10.4a Mounting camera on plate

1. Remove the camera motor, the transfer gear, and the locating stud from camera (some cameras also require removal of projecting inching-knob guard). 2. Loosen two long screws and remove gear box cover from plate. 3. Secure camera on plate with the two long screws (which insert from plate bottom and into the two forward tapped holes of camera). 4. Secure spring-loaded ⅜″-16 camera lock-down screw into bottom rear of camera from plate bottom. 5. Zero the footage counter. 6. Insert three-prong male extension cord from motor into three-prong female plug on front of switch box.

> NOTE: (a) Switch box containing condensor ON/OFF toggle switch slides into pressure catches on motor housing. Long extension on switch box inserts into AC outlet. (b) With unit in blimp, switch box is not used; instead, the three-prong male extension plug on motor is inserted in mating plug in blimp. Six-prong female plug (with condensor in the line) is inserted in recessed six-prong female plug on blimp. (c) Single-jack extension is for sync-pulse cord.

10.5 ARRIFLEX FLAT BASE (Fig. 10-9)

The flat base permits the use of the 35mm Arriflex on a standard tripod head without the Arriflex Adapter Plate. It may be used with a variable- or constant-speed motor.

The bottom of the flat base is fitted with one ⅜″-16 tapped hole to accommodate the tripod lockdown screw. (Some bases may also be fitted with a ¼″-20 tapped hole.)

10.5a Mounting camera on plate

1. Invert camera; remove the motor and the fiber transfer gear. (Older model bases also require removal of front locating stud at camera base; newer bases are fitted with a locating stud receptacle). 2. Insert camera transfer-gear shaft into base of fiber transfer gear. Secure front of camera to base through bottom of plate with three mounting screws; secure rear of camera through bottom of plate with ⅜″-16 lockdown screw. 3. Turn camera rightside up; invert motor; insert motor drive gear in hole to mesh with timing-belt gear. (Short-burst button faces Operator and ON/OFF switch faces right side of base.) Secure motor to base with motor mounting screws.

10.6 ARRIFLEX PERISCOPE FINDER ATTACHMENT (Fig. 10-10)

The Periscope Finder Attachment (PFA) is an optical unit placed between the camera groundglass and the eyepiece. It permits (1) viewing with the left eye, and/or (2) placement of the camera at a desired angle for special or trick shots.

The PFA is provided with three movements: 1. 180° rotation of the front lens around the center of the groundglass in a plane perpendicular to the camera body. 2. 360° rotation of the connecting

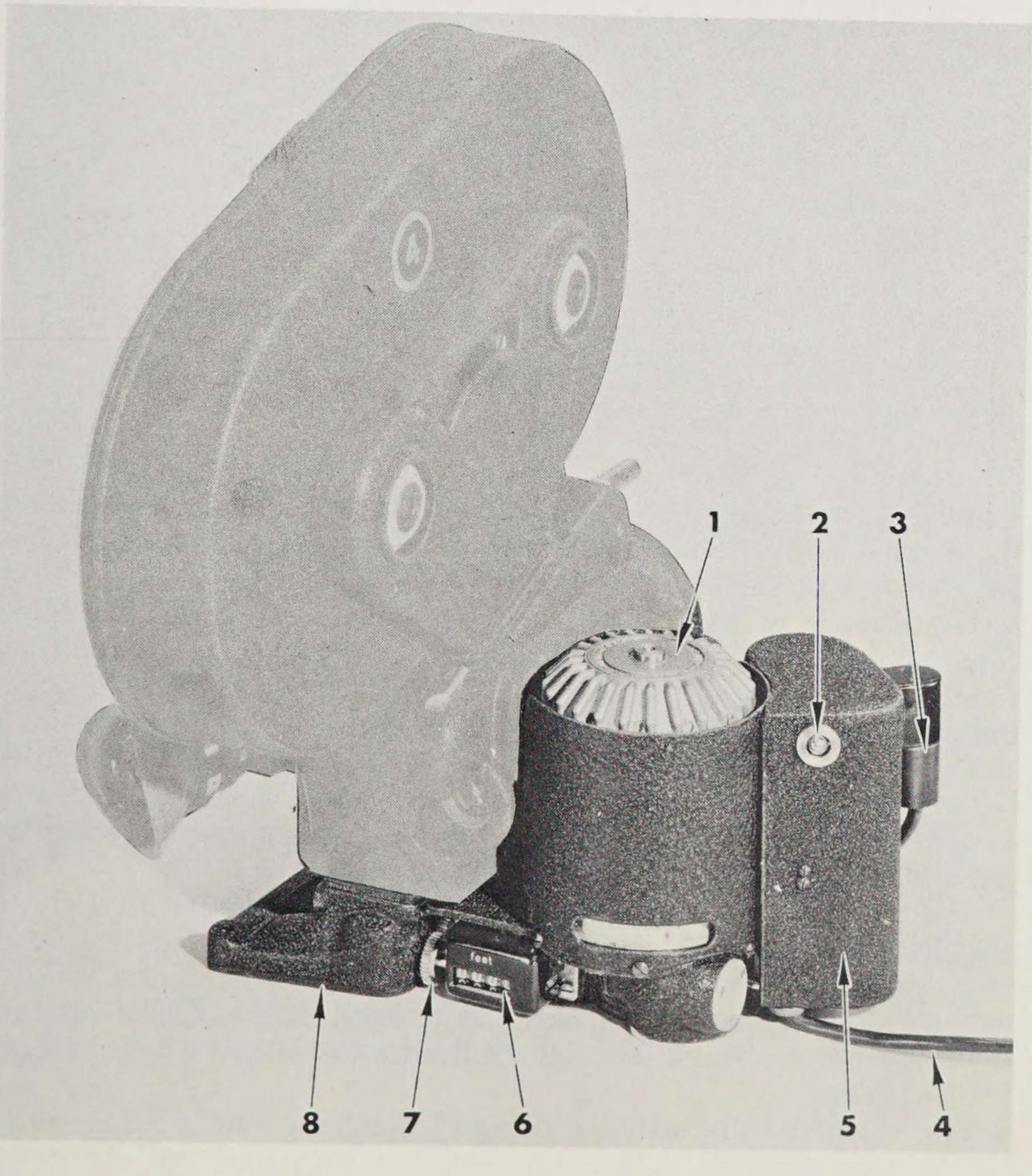


Fig. 10-8. Arriflex 110V synchronous motor on plate. Courtesy of Arnold & Richter K. G.

1. Synchronous motor
2. ON/OFF switch
3. Three-prong plug
4. Line to AC outlet
5. Switch box
6. Footage counter
7. Counter reset knob
8. Camera-mounting plate

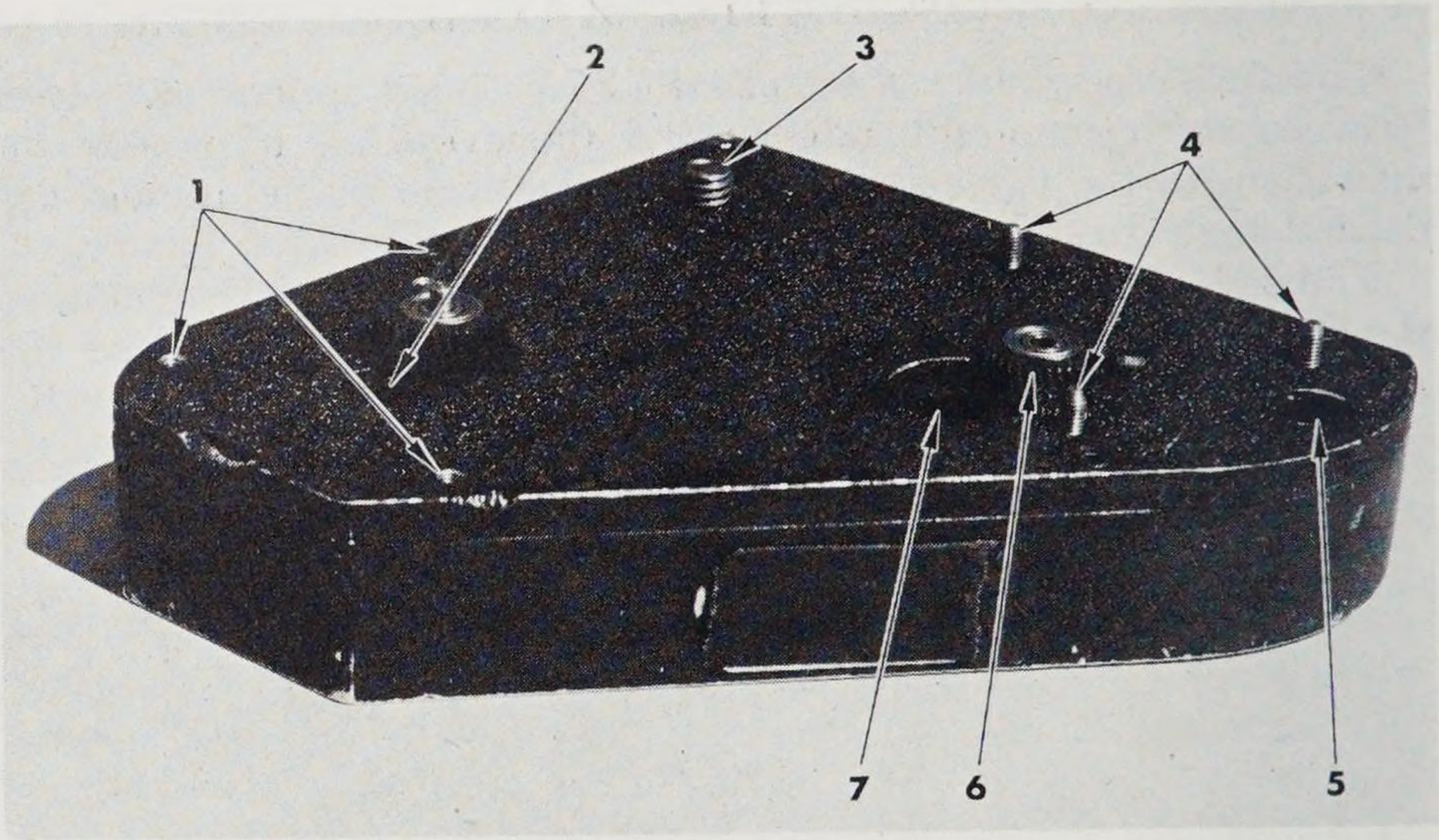


Fig. 10-9. Arriflex flat base. Courtesy of Arnold & Richter K. G.

1. Motor-mounting screw holes
2. Motor drive gear hole
3. Camera lockdown screw
4. Camera mounting screws
5. Locating stud receptacle
6. Base fiber transfer gear
7. Camera gear receptacle

shank between the groundglass and eyepiece in a plane parallel to the camera body. 3. 25° movement of the eyepiece around its own fulcrum in a plane at right angles to the camera body.

The threads at the front lens accommodate the camera eyepiece coupling nut (see Fig. 10-1). The front lens does not have mating lugs (such as are found on the eyepiece) to insert into the mating slots on the camera. This is to allow for the 180° rotation feature of the PFA.

The index ring (secured to the front lens by two screws) is marked by a single red dot. The index ring also has a small knurled shim located on its side. The shim engages the camera eyepiece coupling nut and secures the PFA in position on the camera.

The milled ring on the connecting shank is marked with (a) two red dots, which, when aligned opposite the single dot on the index ring, indicates the *unlocked* position of the knurled shim on the side of the index ring, and (b) a single dot which, when aligned opposite the single dot on the index ring, indicates the *locked* position of the knurled shim.

The triangular-shaped back cover of the front lens is fitted with a button (not shown). When this button is depressed the connecting shank is released and may be rotated 360°.

NOTE: The rotation of the connecting shank causes the image seen in the viewfinder, as well as the aperture outline, to rotate. Although the image seen in the viewfinder may be at a 45° angle, 90° angle, or even upside-down, the image seen by the camera is upright. A simple method to overcome possible disorientation when using this

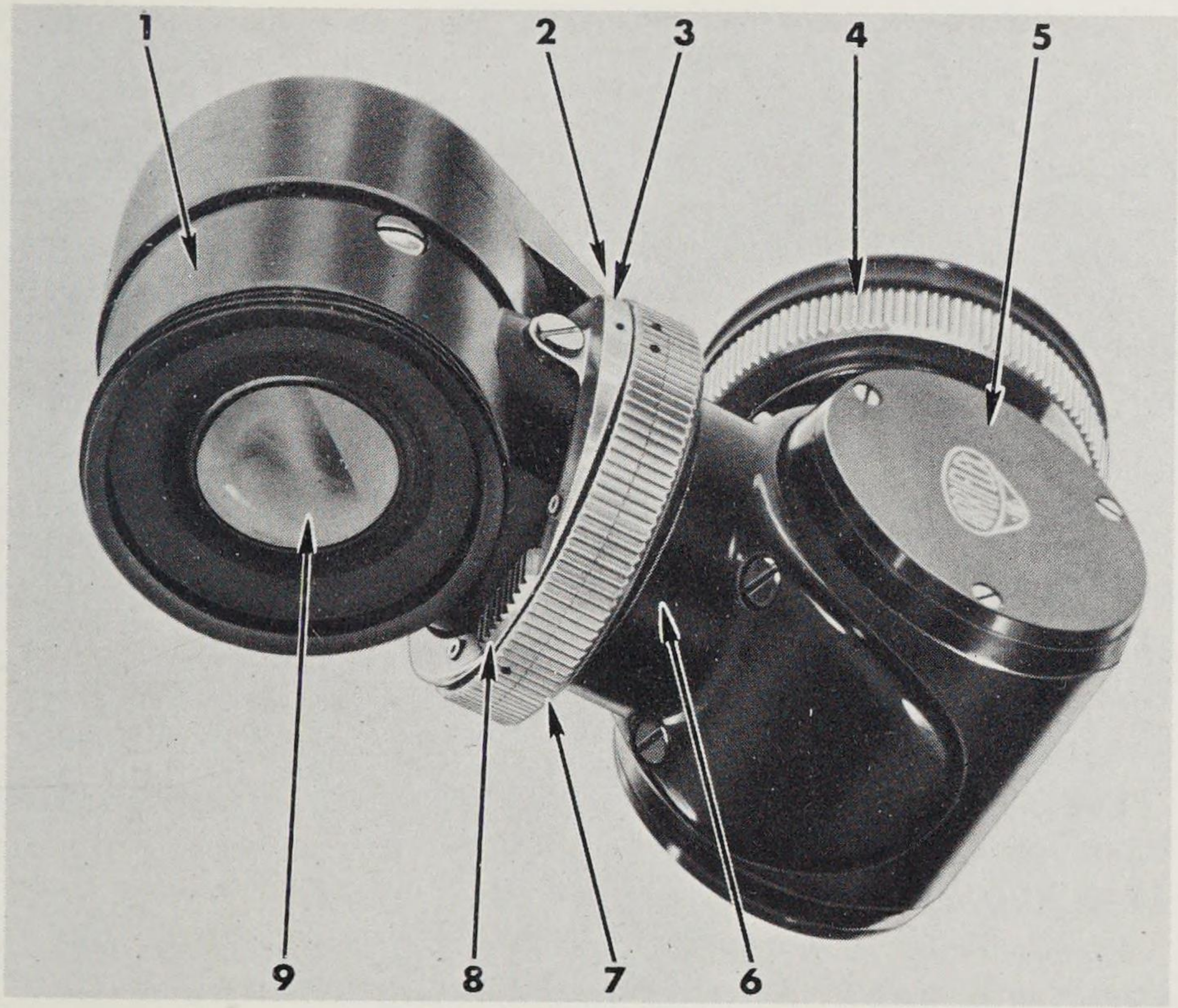


Fig. 10-10. Arriflex periscope finder attachment. Courtesy of Arnold & Richter K. G.

1. 180° rotation
2. Connecting-shank release button (not visible)
3. Index ring
4. Eyepiece coupling unit
5. 25° movement
6. 360° rotation
7. Milled ring (unlocked position)
8. Small knurled shim of index ring
9. Fits front lens to camera

attachment is to align the sides of the viewfinder aperture lines with a vertical object, or align a horizontal object with the top and bottom lines. With a minimum of practice this turns out to be not as complicated as it seems, and the Operator does *not* have to rotate his head to "level out" the picture.

The rear of the PFA is fitted with two slots to accommodate the eyepiece lugs. The PFA coupling nut secures the eyepiece to the unit.

10.6a Mounting

1. Remove the eyepiece from the camera by rotating the knurled camera eyepiece coupling nut clockwise. 2. Make certain *all* lens surfaces are clean. Align the PFA front lens with the camera groundglass and secure.

CAUTION: The camera and eyepiece coupling nuts are double threaded. Unless the units are flush with each other when mounted they will cross-thread (indicating a factory repair job). The coupling

nuts must screw on easily. When difficulty is encountered, unscrew the coupling nut, rotate it at least one full turn, and try again.

3. Place the PFA in the desired position and tighten the camera coupling nut. Turn the milled ring until its single red dot aligns with the indexing dot. This causes the small knurled shim on the index ring to engage the camera coupling nut and hold the PFA in position.

NOTE: If the knurled shim fails to hold the PFA in position: (a) rotate the milled ring until the two red dots align opposite the index dot, (b) tighten the camera coupling nut even more, so that the next tooth of the coupling nut will be engaged when the single red dot on the milled ring is aligned with the index ring.

4. Insert the two guide pins of the eyepiece into the two guide keys at the rear of the PFA; rotate the knurled PFA coupling nut counterclockwise to secure it to the unit.

10.7 ARRIFLEX 16S CAMERA* (Figs. 10-11, 10-12)

NOTE: All directions are from the Operator's point of view.

10.7a Base

Bottom fitted with ⅜"-16 and ¼"-20 tapped holes to accommodate tripod lockdown screws.

10.7b Motors

Governor-controlled (constant-speed) motor (not shown): Inching knob is at the back of the motor. Motor does *not* reverse.

Variable-speed motor (Fig. 10-12): Small knurled knob at rear is inching knob. Larger knurled knob at rear is the FWD/REV switch, which must be rotated clockwise for forward, counterclockwise for reverse.

To adjust variable-speed motor: Rotate entire ribbed motor shell (which is a rheostat) clockwise for fast, counterclockwise for slow. The motor-speed scribe marks on the rheostat are for reference only. Correct frame-per-second speed is obtained by observing the tachometer.

To mount either motor: Loosen motor lock lever counterclockwise. Rotate motor until cylinder-locating pin aligns with keyway (approximately "7 o'clock"). Insert motor into motor cavity firmly until cylinder shoulder abuts camera box housing. Rotate locking lever clockwise.

To remove motor: Loosen motor locking lever counterclockwise. Pull motor straight back.

NOTE: A minimum of 8 volts is required to run a camera with a 400-ft load. A 110V AC line requires a stepdown transformer/rectifier.

Magazine torque motor (Fig. 10-12): Fits to back side of magazine. The unit is essential when using 200-ft or 400-ft magazines on the camera.

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*Manufacturer states the designation "S" is for Standard.

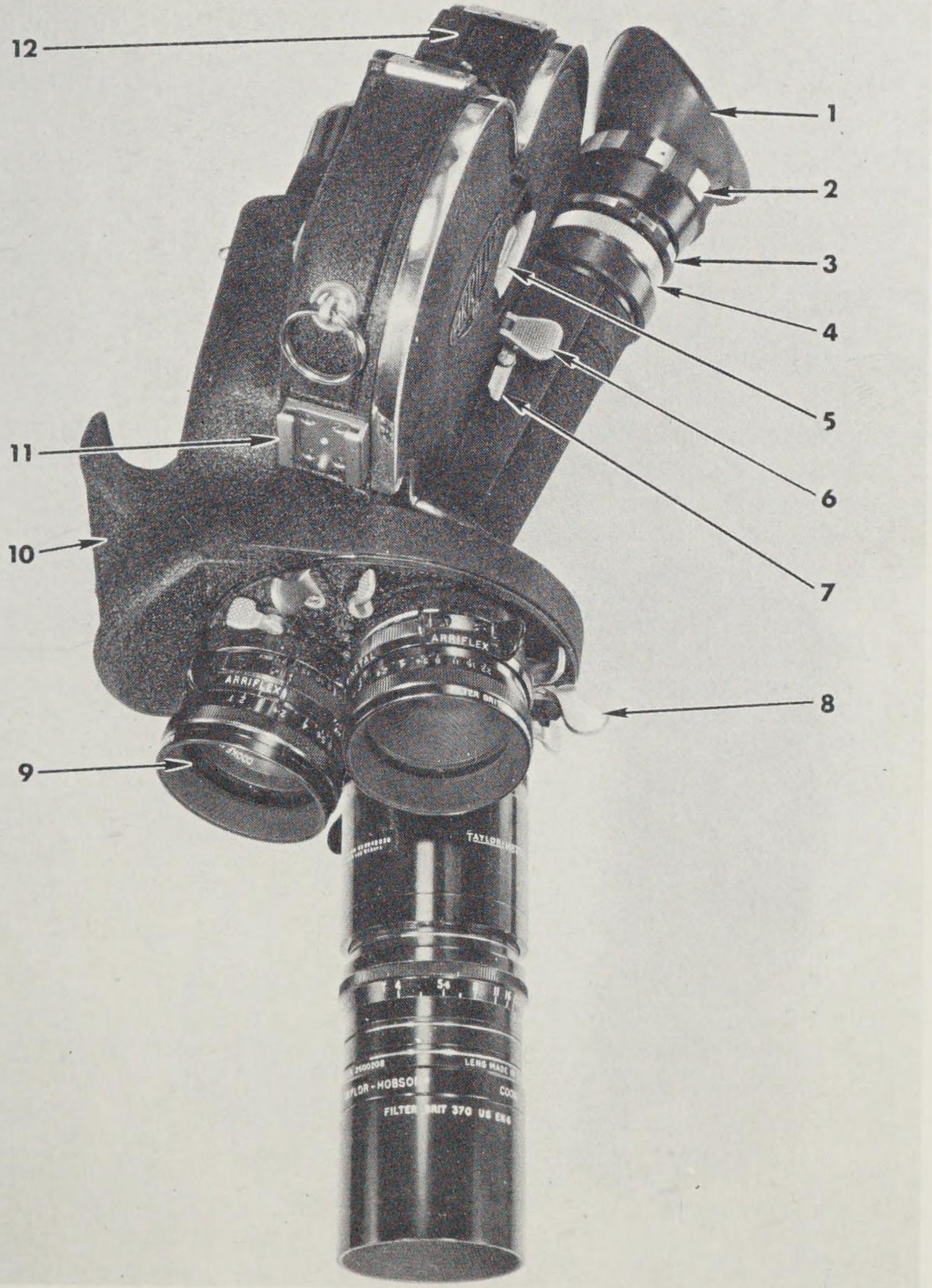

Fig. 10-11. Arriflex 16S 100-ft spool configuration (without matte box, top view). Courtesy of Arnold & Richter K. G.

1. Eyecup
2. Focusing ring
3. Focus locking ring
4. Eyepiece coupling nut
5. Door lock
6. ON/OFF switch
7. Lock release
8. Turret grip
9. Taking lens
10. Contour grip
11. Matte-box boom shoe
12. Cavity cover

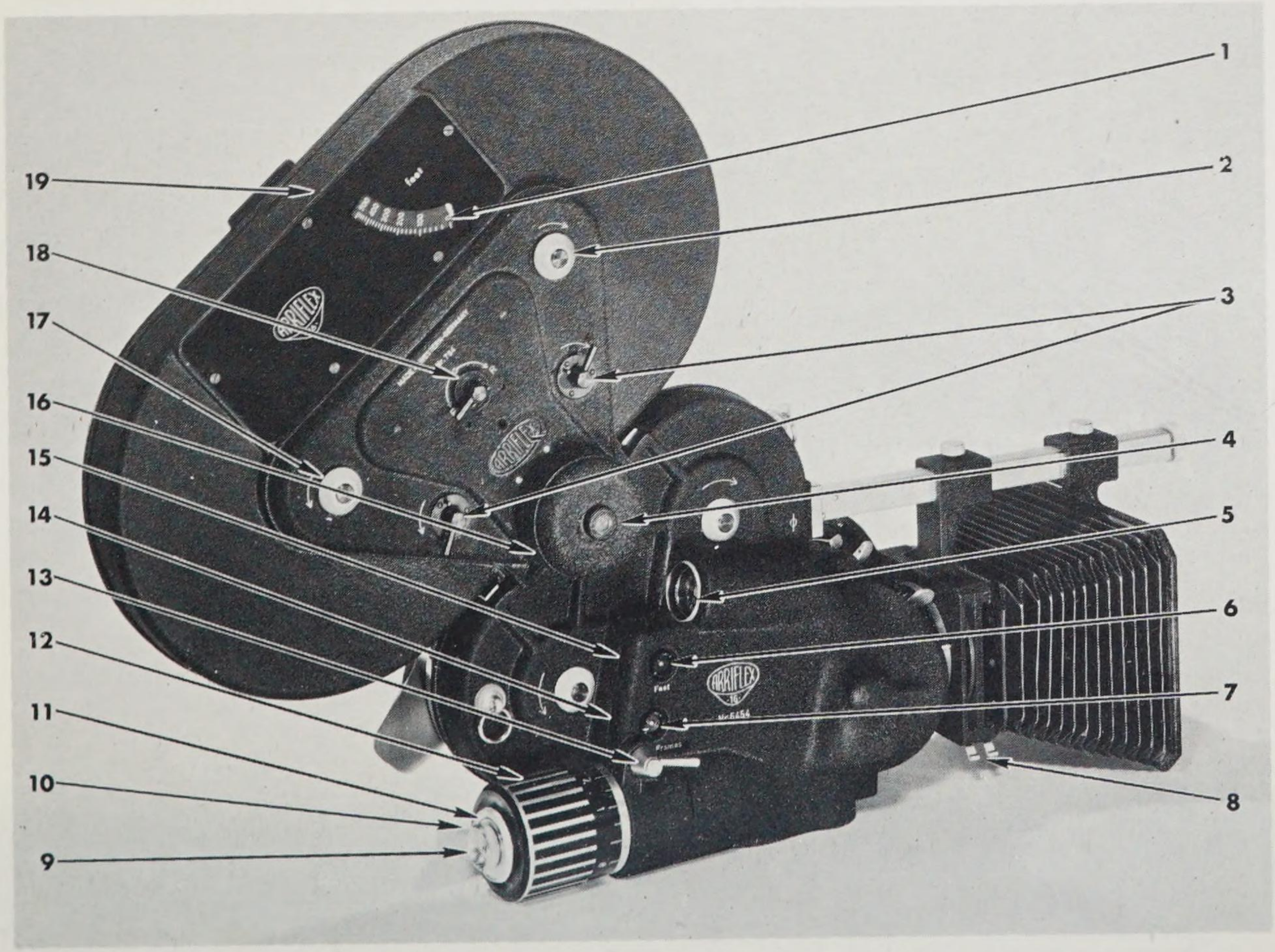

Fig. 10-12. Arriflex 16S with matte box and 400-ft magazine. Courtesy of Arnold & Richter K. G.

1. Magazine footage counter
2. Knurled magazine feed wheel
3. Torque motor lock levers
4. Torque motor
5. Tachometer
6. Footage reset disc
7. Frame reset disc
8. Filter holder
9. Inching knob
10. Power-cable socket (not visible)
11. Motor FWD/REV switch
12. Variable-speed motor
13. Motor locking lever
14. Frame counter
15. Footage counter
16. Groundwire receptacle (not visible)
17. Knurled magazine take-up wheel
18. Torque motor FWD/REV switch
19. 400-ft magazine

To mount torque motor on magazine: Place magazine with the lid down and subtractive footage counter up. Rotate torque motor lock levers (at each side of motor drum) *up*. Insert lock-lever catches of motor into magazine keyways. Rotate lock levers out and down (follow arrows) to secure. Set direction lever on "F" (forward) or "R" (reverse) to coincide with the direction set on the camera motor. After each take, rotate knurled magazine take-up wheel to remove film slack.

A *groundwire receptacle* is at the base of the motor drum.

To "ground" the torque motor: Insert one end of the groundwire into the motor groundwire receptacle and the other end into the groundwire receptacle on the female end of the power-line plug (see Sec. 10.7c).

To reverse motor with 400-ft magazine attached: Set large knurled knob (at rear of camera motor) counterclockwise to "R." Set magazine torque motor to "R." Cover lens when running film back to beginning of scene intended for double exposure.

The following motors are available for the Arriflex 16S:

Variable-speed motor: 8V DC.

Governor-controlled (constant-speed) motor: 8V DC (16 fps), 8V DC (24 fps), 8V DC (25 fps).

Synchronous motor: 110V AC 60 Hz (24 fps) with step-down transformer/rectifier for 8V DC to torque motor. 110V AC 50 Hz (25 fps) with step-down transformer/rectifier for 8V DC to torque motor.

Animation/time lapse motor: 110V AC 60 Hz, 110V AC 50 Hz.

NOTE: Animation motors require intervalometer for time lapse photography.

10.7c Power line

Input to camera: Power-cable socket is located at rear of the camera base (left of motor). Split recessed socket pins may be separated slightly to secure the female cable plug snugly on the pins.

CAUTION: The metal pins are very fragile and will break if separated roughly.

A latch above the socket (see Fig. 10-13 for detail) engages a rubber catch on the female plug and holds it in proper polarity. Plus (+) is the left pin, closest to the door.

The female plug may have a groundwire receptacle (below the rubber catch) which accommodates the other end of the groundwire that should be inserted into the torque motor groundwire receptacle (see Sec. 10.7b).

The male end of the cable should be inserted into the battery. Plus (+) on plug aligns with red plus (+) on battery. The male split pins may be wedged apart slightly to obtain a snug fit.

If there is a pressure catch on the cable attach it to a battery hold-down lock to hold the male plug securely to the power source.

ON/OFF switch is in door. Push lever down to turn power on; lever locks into place. Depress lock release (forward of the lever) to turn power off.

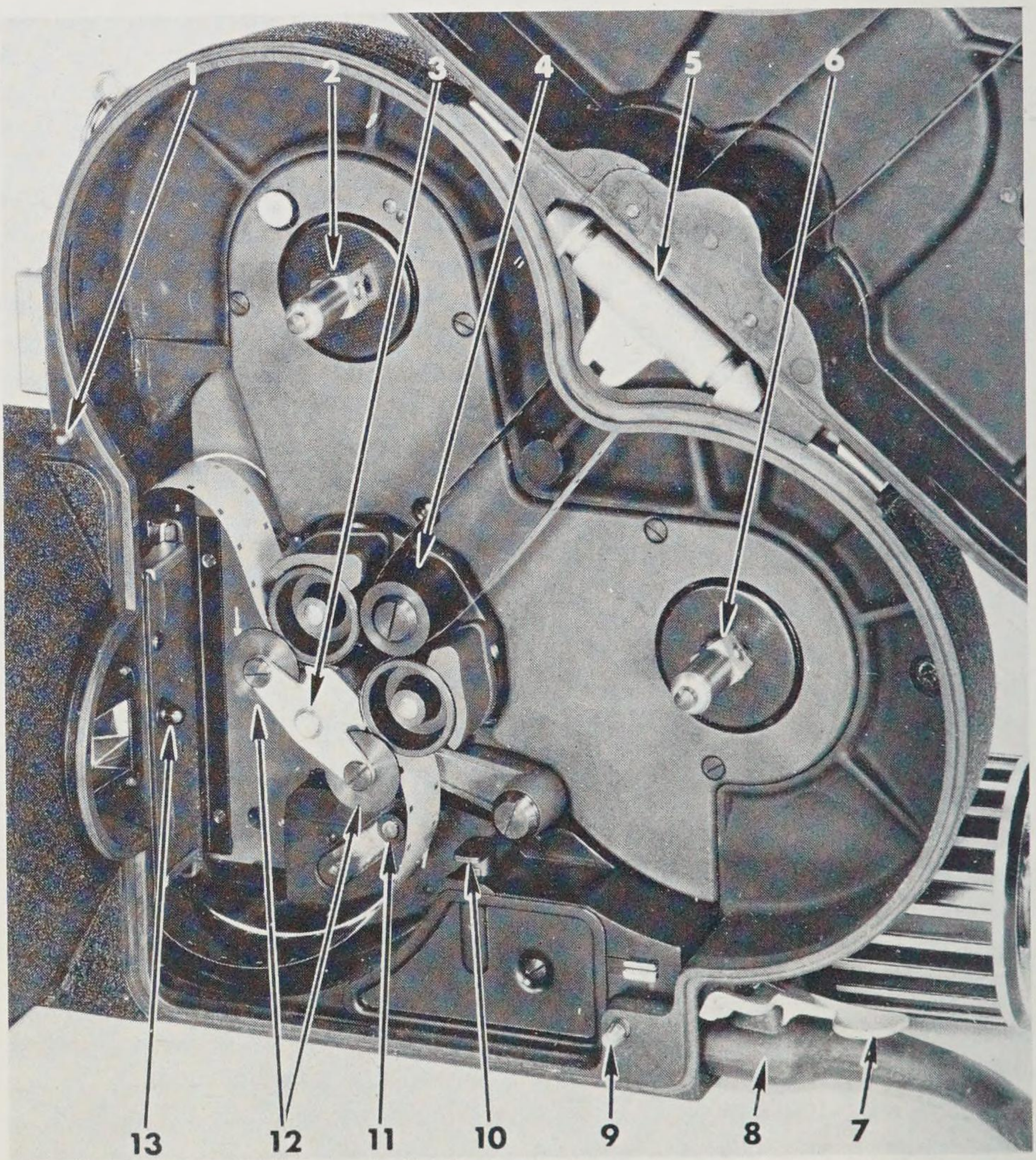

Fig. 10-13. Arriflex 16S threading detail (magazine cover removed to show film path). Courtesy of Arnold & Richter K. G.

1. Door guide pin
2. 100-ft spool feed spindle
3. Pivot-pin button
4. Central roller
5. Magazine lock lip
6. 100-ft spool take-up spindle
7. Power-cable latch
8. Power-cable to power cable socket
9. Door guide pin
10. Internal ON/OFF switch
11. Buckle-trip
12. Spring-loaded sprocket-guide rollers
13. Pressure pad catch

NOTE: When using a pistol-grip accessory fitted with a plunger, the trigger acts an an ON/OFF camera switch, bypassing the ON/OFF switch in the camera door. Insert pistol-grip into the ⅜"-16 tapped hole in the camera base.

10.7d Turret: Three-position. 21° divergent ports.

To rotate: Grasp turret grip opposite taking lens. Depress (or lift)

until desired lens rotates into position nearest the contour grip at the right side. Turret snaps into place.

NOTE: Turret grips have indented data marks which are visible to the Operator and help him to determine which lens is in the "taking" position, i.e., the widest-angle lens, one dot; the normal lens, two dots; and the telephoto lens, three dots. Each lens should be mounted opposite the data mark to which it corresponds.

10.7e Lenses

To mount on turret: Rotate lens barrel until channel in the mount aligns with the infinity mark on the lens. Grasp lens by its knurled footage ring. Squeeze locking levers at each side of the lens port on the turret and insert the lens into the port with the follow-focus grips ("wings") *up*. Slide the channel at the rear of the mount over the guide key inside the lens port. Release the locking levers. Gently tug at lens to make certain the levers have gripped the channel at the rear of the lens mount.

NOTE: Lenses should correspond as closely as possible to the data marks on the turret grips.

To remove lens: Rotate follow-focus grips *up*. Grasp knurled footage ring. Squeeze locking levers at each side of lens port, and gently pull lens away.

CAUTION: When using less than three lenses, always plug the empty port(s) to avoid a light leak to the aperture.

NOTE: 16mm and 35mm Arriflex lenses are interchangeable with the following *exceptions:* 5.7mm, 10mm, 11.5mm, 16mm, and 25mm. These will *not* "cover" a 35mm aperture. The only wide-angle lenses that *will* "cover" a 35mm aperture are: 9.8mm, 14.5mm, 18.5mm retrofocus, and the 28mm *made for 35mm cameras.*

10.7f Viewfinder: Reflex. Image magnified 10×.

To align reflex mirror for viewing: Rotate inching knob at rear of motor.

To detach eyepiece: Rotate knurled eyepiece coupling nut on viewfinder clockwise and pull eyepiece from keyed slots.

Hinged metal cap (not shown): Closes viewing system. This cap must be closed when Operator's eye is not covering the eyepiece so that stray light cannot strike mirror and "kick back" onto film.

To focus: Newer models (Fig. 10-11): Rotate narrow scalloped ring on eyepiece clockwise to the word "lose" (loose). Rotate large scalloped ring nearest the eyecup to focus on the groundglass. When focus is set, turn the narrow ring counterclockwise to "fest" (tight). *Older models* (not shown): Loosen small lever on eyepiece. Rotate barrel to scribes numbered with "+" or "−" diopter settings. Focus on groundglass. When focus is set, lock small lever.

Groundglass: Behind eyepiece. Views full aperture. Cannot be changed on the job.

To clean: Remove eyepiece to expose the smooth surface of the groundglass.

10.7g Sunshade/matte box

Either end of sunshade/matte box slides in and out on square boom.

To mount: Insert notched plate at rear of boom into shoe on camera housing above turret. Rotate knurled knob at front of boom until locking pin engages centering hole of shoe.

10.7h Filters

Holders (with retaining springs) house two 2 × 2 in. glass filters, or two 2 × 2 in. gelatines, which slide into a separate gel frame. The gel frame clips into the holder.

NOTE: The rear filter housing rotates. The threaded opening at the rear housing accepts an adapter to hold a Series 8 glass filter.

To insert filter: Slide two "keyed" filter holders into left side of the matte box. Spring catch of housing must engage notch in holder.

To disengage filter holders: Depress catch at bottom right of matte box and slide holder out.

10.7i Door: Dog-locked.

To remove: Rotate recessed door lock counterclockwise to "O."

CAUTION: Door is not hinged.

To close: Turn door lock to "O." Align door with contour of camera and secure lock clockwise to "C." Grasp finder and pull gently to ascertain door is properly secured to the camera.

10.7j Magazines: 200-ft and 400-ft (shown).

To mount:

1. Rotate FWD/REV switch on *torque motor* counterclockwise to "F" (FWD). Rotate large knurled knob on *camera motor* clockwise to "F." 2. Lift lock lip (on nose of magazine) up. Pull pressure-locked cavity cover from top of camera housing. 3. Pull loop of film from feed side and insert it into camera cavity. 4. Seat rear male dovetail that is on the magazine nose into the rear female dovetail of camera housing; then lower front male dovetail into camera housing. 5. Press lock lip down until magazine locks into camera housing.

CAUTION: Hand tighten only! Lock lip does not necessarily seat flush with the magazine. Do *not* force it down!

6. Hook spring-loaded lock-lip catch into lock lip. Thread camera (Sec. 10.7k).

To remove magazine: Unthread camera. Remove lock-lip spring; lift lock lip *up*. Raise magazine. Replace cavity cover on camera.

10.7k Threading (Fig. 10-13)

1. Depress pressure-pad catch and swing the hinged pressure pad open. 2. Depress pivot-pin button on sprocket-guide roller assembly (located below and to the left of the sprockets) and move the spring-loaded rollers away from the sprockets. 3. Rotate inching knob either

way until single registration pin enters the gate and the single pull-down claw is withdrawn from the gate. 4. Insert film into gate and engage a perforation on the registration pin. Hold film with thumb and forefinger and rotate the inching knob until the pulldown claw engages a perforation. Close pressure pad with thumb pressure.

CAUTION: It is extremely important to double-check that pressure pad catch is engaged!

5. Conform upper film loop to scribed line in camera. Insert film to left of central roller, then between upper sprocket-guide roller and sprocket. Engage perforations on sprocket; swing upper sprocket-guide roller toward sprocket to hold film in place. 6. Conform lower loop to scribed line in camera. Insert film between lower sprocket-guide roller and sprocket, then to right of central roller. 7. Push sprocket-guide roller assembly *gently* toward sprockets. Rotate take-up wheel counterclockwise on torque motor to pull up slack.

CAUTION: Slack film on the take-up side can loop under the 100-ft spool take-up spindle inside the camera while it is being pulled up into the magazine. This could result in a full roll of scratched film.

8. Depress internal ON/OFF switch and observe action of the film. If satisfactory, turn off camera and close the door.

NOTE: 100-ft daylight spools are threaded the same as above, except that the spools are placed on the spindles within the camera housing.

10.7l Buckle-trip

Located below the lower spring-loaded sprocket-guide roller (Fig. 10-13). The roller on the buckle-trip arm cuts out power when pulled up by a short lower loop. It also prevents the film end from running through the gate, or film from piling up in the camera.

NOTE: Earlier models (not shown) may not have a buckle-trip.

To reset: Depress pivot-pin button on the sprocket-guide roller assembly. When assembly opens, the buckle-trip is automatically reset.

Override: If buckle-trip microswitch fails to reset, push plunger in door below eyepiece. The narrow base of the toggle lever will pivot forward when the plunger strikes the heavy side of the lever. The buckle-trip will not function thereafter.

To cut out override: Place forefinger on narrow base of the toggle lever and push the base toward rear of camera.

10.7m Footage and frame counters: Located at back of camera above motor. Additive.

Footage counter: Registers 0–118 ft in increments of 2 ft, then reverts to zero. Applies to daylight spools or 200-ft magazines. When 400-ft magazines are used, the magazine counter is utilized.

Frame counter: Registers 0–39 frames in increments of 1 frame, then reverts to zero.

To reset either counter: Rotate separate reset discs located at right of counters.

10.7n Tachometer

Located at rear of camera above footage counter. Registers speeds from 0–50 fps, in increments of one frame per second.

CAUTION: Camera is not governor controlled. A variable-speed motor *can and will* run faster than 50 fps. It cannot be assumed that by arbitrarily turning the rheostat so that the needle registers 50, the camera is running at 50 fps. Incorrect exposure can result if the camera speed is not deliberately and conscientiously set by the Cameraman.

10.7o Shutter: Nonadjustable. Equivalent to 180°.

10.7p Lubrication (Fig. 10-14)

Manufacturer recommends six to eight drops of oil on the following parts every 30,000 ft:

1. Depress top ball bearing oil valve above sprockets to lube intermediate counter gear. 2. Depress ball bearing oil valve near film gate to lube intermediate shutter gear.

CAUTION: Manufacturer warns that oiling too frequently and/or excessive oil can damage the camera mechanism.

3. Rollers: one drop of oil.

NOTE: After oiling, run camera to eliminate excess oil and wipe clean.

10.7q Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Open pressure pad and check the plate and pad for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

10.7r Weight: (with 400-ft load) 14-1/2 lb.

10.7s Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Battery connections loose; roller guides not closed against sprockets; battery dead; motor not making contact; buckle-trip not reset
Intermittent starting and stopping	Slotted power-line prongs (either in battery or camera) squeezed together, making poor contact; lugs in battery loose; broken connection in power line
Torn sprockets; ripped film	Improper threading
Loops pull taut each time camera starts	Camera motor switch is forward while torque motor switch is in reverse (or vice versa)

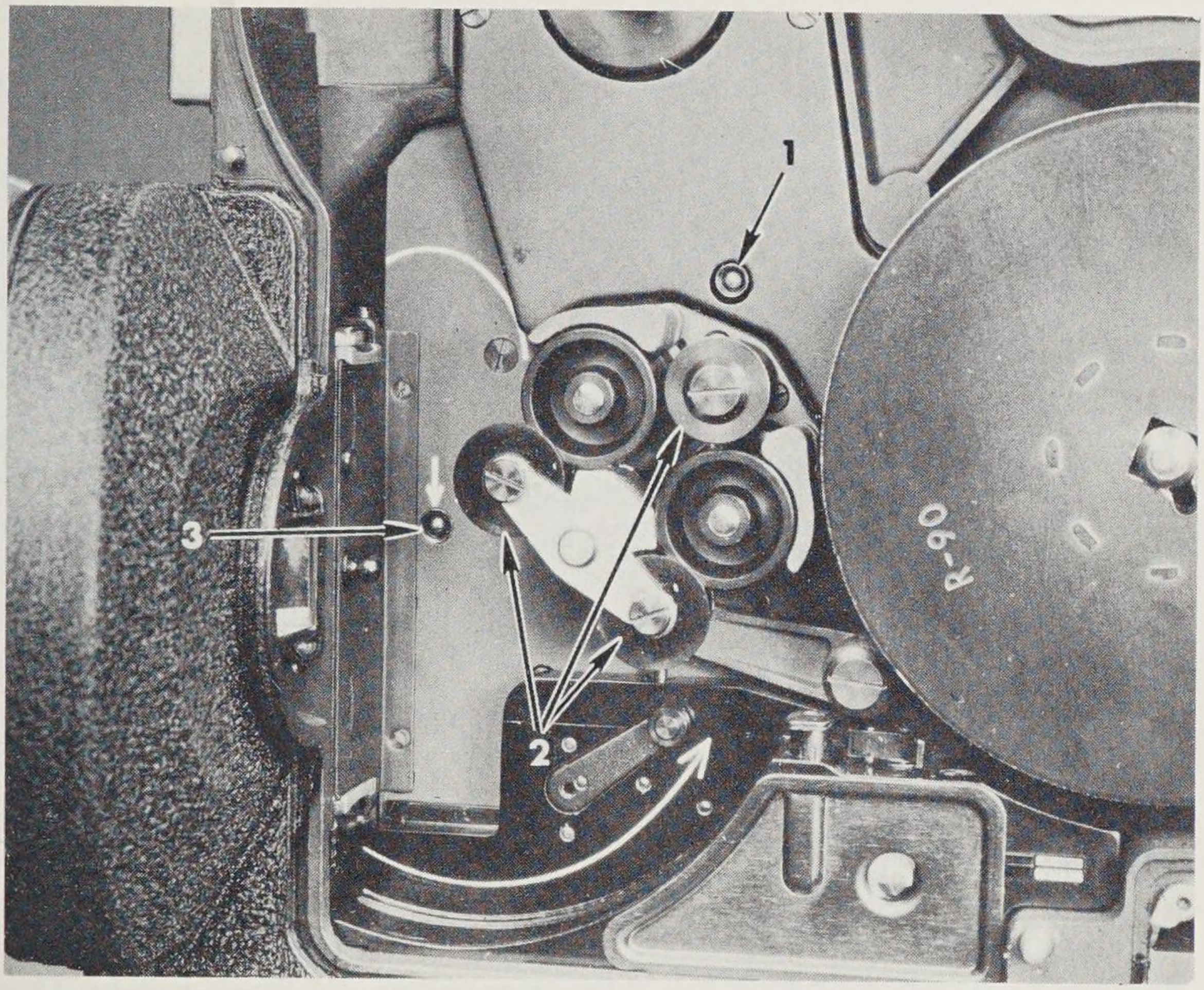

Fig. 10-14. Arriflex 16S lubrication. Courtesy of Arnold & Richter K. G.

1. Intermediate counter gear
2. Rollers
3. Intermediate shutter gear

Trouble	*Probable Cause*
Door will not close	Camera "ON" switch depressed; dirt or film chip in door recess
Viewing system blacked out	Shutter closed; eyepiece cap closed; lens stopped down past *f*/22; lens cap on
Lens will not focus	Lens not seated; camera too close for minimum distance of lens; elements damaged
Cut-in on groundglass (wide-angle lens)	Viewing mirror "sees" aperture of lens, but camera aperture does not—no problem if turret is seated properly
Cut-in on groundglass (normal lens)	Turret not seated; matte box extended
Lens will not enter port	Guide key inside turret bent up or down, therefore will not enter lens channel
Torque motor does not take up	Contact pins on magazine and/or motor not touching (or dirty); contact spring on magazine is loose or dirty; FWD/REV switch in neutral position

Trouble	*Probable Cause*
Film does not take up in magazine	Magazine take-up spindle loose; film loose on take-up core; torque motor FWD/REV switch in neutral position

10.8 ARRIFLEX 16S MAGAZINES (Fig. 10-15)

10.8a Type: Displacement.

10.8b Capacity: 400-ft (shown) and 200-ft (not shown).

10.8c Lid

One. Lug- and dog-locked. To open, depress safety spring in lid recess, rotate lock bar counterclockwise (from "C" to "O"). Lift.

10.8d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

10.8e Take-up

Right side. Film winds on spindle clockwise, emulsion always in.

10.8f Loading

1. Remove lid. Swing footage-counter/roller-guide arm *up* and lock into catch near top of magazine. Swing take-up roller-guide arm *up* and lock into catch below the counter arm. 2. In darkness, remove film roll from can and bag. Pull film off roll clockwise. Insert film end through feed side and past the light-trap rollers. 3. Place roll on feed spindle. Rotate knurled feed-spindle wheel until spindle key engages the core keyway. 4. Insert film through take-up side light-trap rollers, and into magazine interior. 5. Hold core. Rotate knurled spindle wheel until spindle key engages the core keyway. Insert film end into core slot, and wind up on take-up spindle clockwise (emulsion in). 6. Lower take-up roller-guide arm and feed (footage-counter) roller-guide arm, making certain that film rides between the flanges of the roller guides of both arms.

To replace lid: While holding the magazine lid at a 45° angle, insert the lid lugs (at bottom) into mating slots in the magazine, then lower the lid to a secure fit. Rotate the lid lock bar clockwise from "O" to "C" until safety spring snaps up. Pull on lid and run fingernails around its edge to make certain that lid is locked properly.

To take out film slack: Rotate knurled spindle wheels at back of magazine. Take-up rotates counterclockwise. Feed rotates clockwise.

To load daylight spools: Depress center of core spindles. Remove core holders. Place spools on square driver pins of spindles. Swing take-up roller-guide arm and feed (footage-counter) roller-guide arm *up* and lock into their catches.

Film-loop guard: The 16S has *no* film-loop guard. Guards are only manufactured for the 35 IIC, 16M, and 16BL.

10.8g Unloading

In darkness, open lid and swing the take-up roller-guide arm *up* and lock into its catch. Place middle finger on core and thumb on

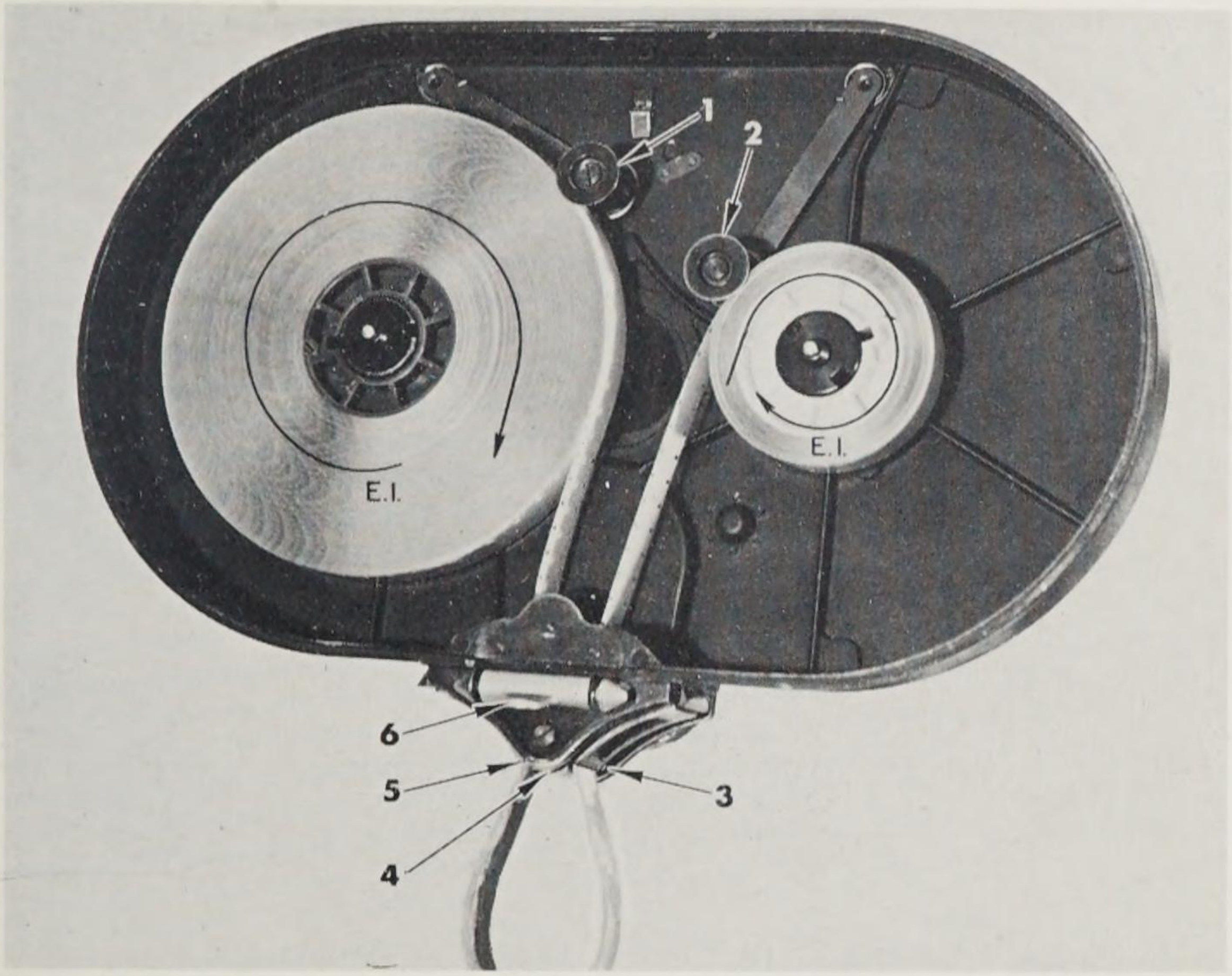

Fig. 10-15. Arriflex 16S 400-ft magazine. Courtesy of Arnold & Richter K. G.

1. Feed roller guide
2. Take-up roller guide
3. Take-up light trap
4. Magazine nose
5. Feed light trap
6. Magazine lock lip

edge of film roll. Turn magazine over, remove film and place roll in bag and can.

10.8h Footage counter

At back of magazine above the torque motor. Subtractive; 500–0 ft in increments of 20 ft.

10.8i Torque motor: See "Magazine Torque Motor" in Sec. 10.7b.

10.9 ARRIFLEX 16M CAMERA* (Figs. 10-16, 10-17)

NOTE: All directions are from the Operator's point of view.

10.9a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lock-down screw.

To align camera correctly on tripod: "Square" the right side of the base with the tripod head.

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*Manufacturer states the designation "M" is for magazine.

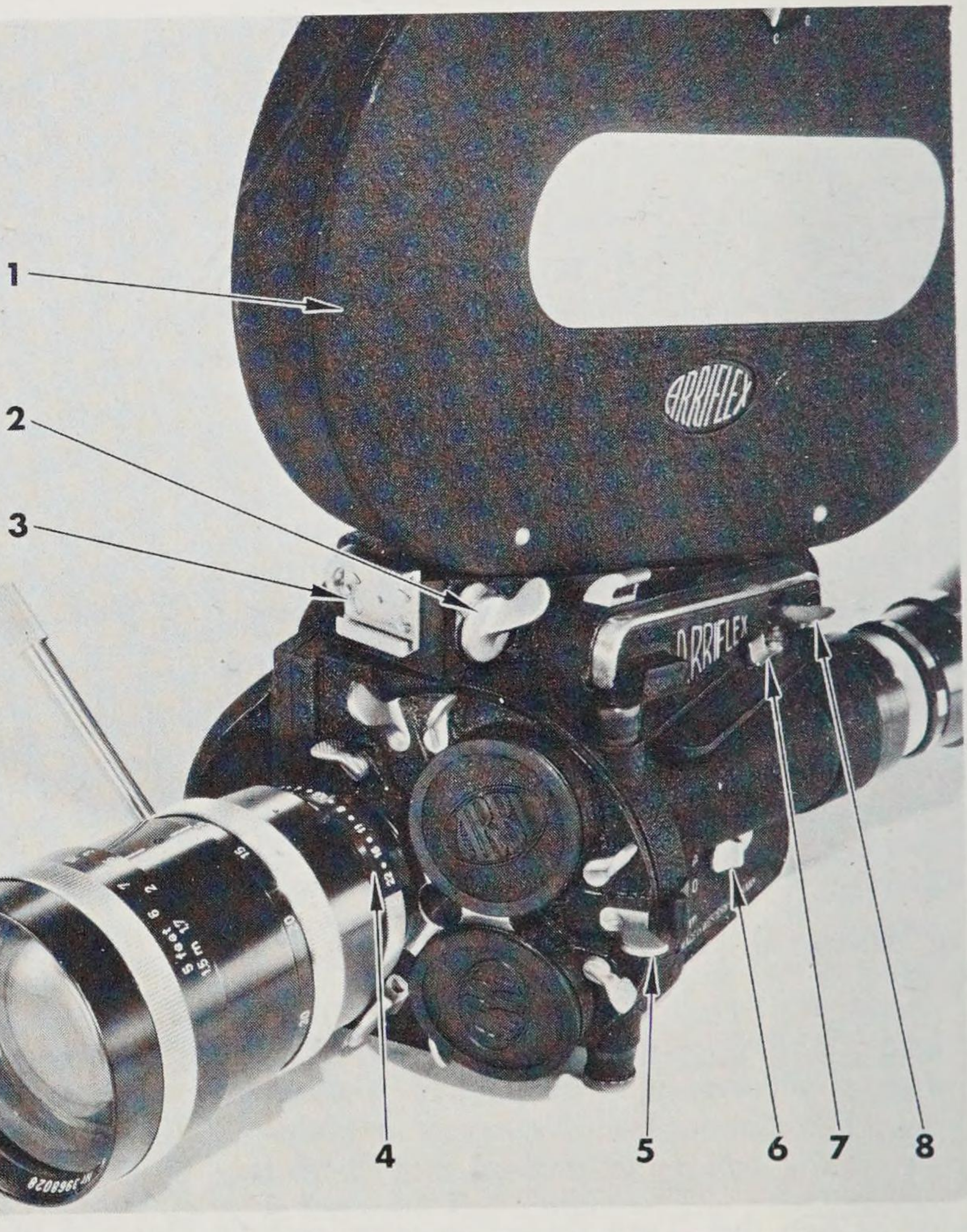

Fig. 10-16. Arriflex 16M with Zeiss 12.5–75mm Vario Somnar zoom lens (left front). Courtesy of Arnold & Richter K. G.

1. 400-ft magazine
2. Magazine lock
3. Sunshade boom shoe
4. Taking lens position
5. Turret grip
6. Door latch
7. Lock release
8. ON/OFF switch

10.9b Motor

Constant-speed motor (not shown) has an inching knob at the back of the motor.

Variable-speed motor (Fig. 10-17): Small knurled knob at rear is the inching knob. Larger knurled knob at rear is the FWD/REV switch; knob must be rotated clockwise for forward, counterclockwise for reverse.

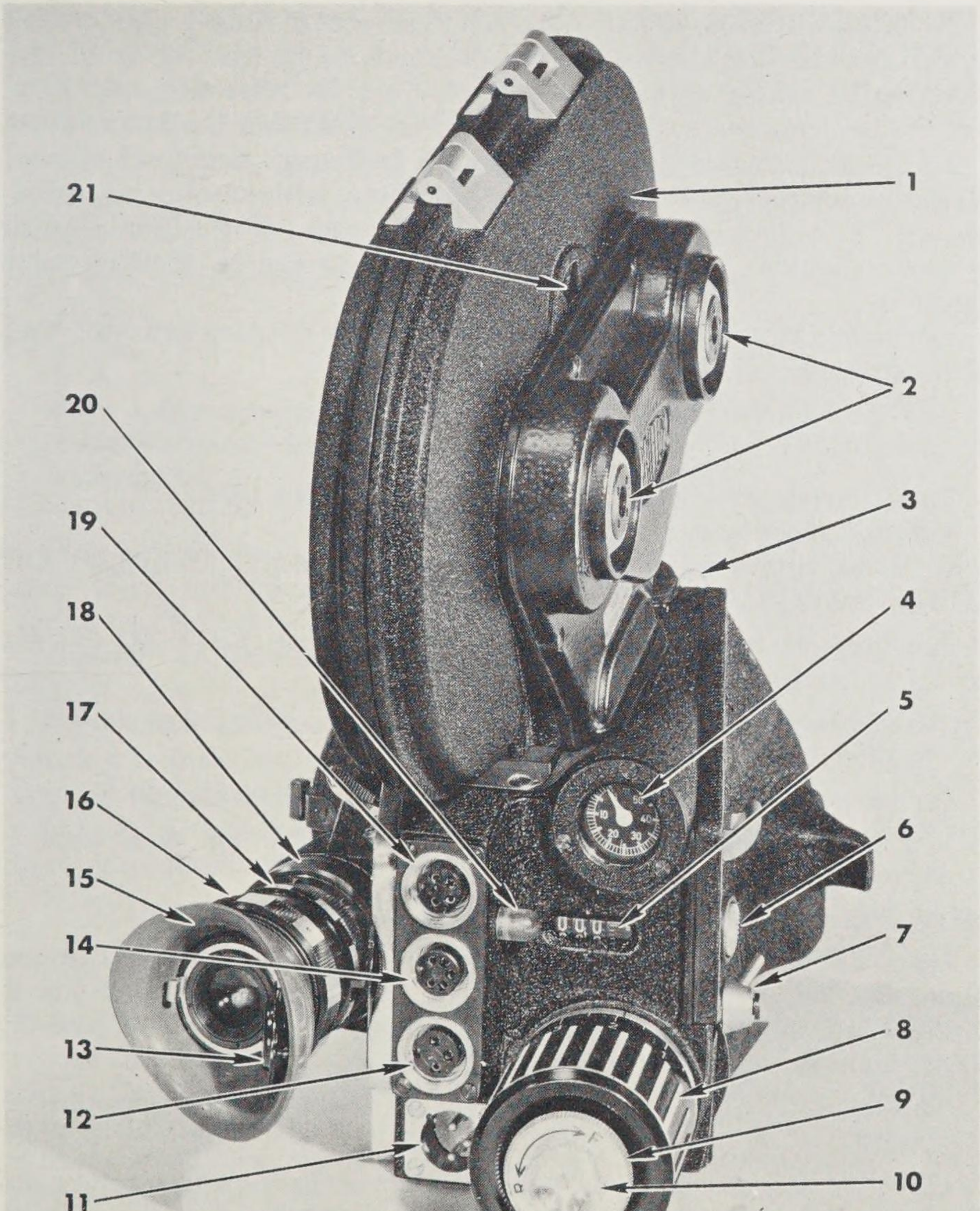

Fig. 10-17. Arriflex 16M with 200-ft magazine (rear view). Courtesy of Arnold & Richter K.G.

1. 200-ft magazine
2. Spindle wheels
3. Exterior full-frame exposure bulb
4. Tachometer
5. Footage and frame counters
6. Counter reset knob
7. Motor lock
8. Variable-speed motor
9. FWD/REV switch
10. Manual inching knob
11. Power plug
12. Spare power plug
13. Hinged metal cap
14. Sync-pulse plug
15. Eyecup
16. Focus knob
17. Focus lock
18. Eyepiece coupling nut
19. Blank plug
20. Exterior edge-marking bulb
21. Magazine footage counter

To adjust variable-speed motor: Rotate entire ribbed motor shell (which is a rheostat) clockwise for fast, counterclockwise for slow. The motor-speed scribe marks on the rheostat are for reference only. Correct frame-per-second speed is obtained by observing the tachometer.

To mount either motor: Loosen motor lock lever counterclockwise. Rotate motor until cylinder-locating pin aligns with keyway (approximately "7 o'clock"). Insert motor into motor cavity firmly until cylinder shoulder abuts camera box housing. Rotate locking lever clockwise.

To remove motor: Loosen motor locking lever counterclockwise. Pull motor straight back.

NOTE: A minimum of 8 volts is required to run camera with a 400-ft load. A 110V AC line requires a step-down transformer/rectifier.

The following motors are available for the Arriflex 16M:

Variable-speed motor: 8V DC.

Governor-controlled (constant-speed) motor: 8V DC (16 fps), 8V DC (24 fps), 8V DC (25 fps).

Synchronous motor: 110V AC 60 Hz (24 fps), 110V AC 50 Hz (25 fps).

NOTE: 16M has *no* need for step-down transformer-rectifier as does the 16S.

Animation/time lapse motor: 110V AC 60 Hz, 110V AC 50 Hz.

NOTE: Animation motors require intervalometer for time lapse photography.

10.9c Power line

Input to camera: Cannon female end of cable fits to lowest Cannon male plug on panel at back of camera. Male end of power line is inserted into battery. Plus (+) on cable fits to red plus (+) on battery. Split pins may be separated to obtain a snug fit.

CAUTION: The pins are very fragile and will break if separated roughly.

ON/OFF lever switch is in door. Push lever down to turn power on; the lever locks into place. Depress lock lever (forward of the switch) to turn power off.

NOTE: When using a pistol-grip accessory fitted with a plunger, the trigger acts as an ON/OFF camera switch, bypassing the ON switch in the camera door. Pistol-grip is inserted into the ⅜"-16 tapped hole in the camera base.

Panel of four outlets at back of camera (Fig. 10-17): One Cannon plug, and three Tuchel plugs. Starting from the bottom and working up, they are:

Plug No. 1: Three-pin Cannon plug for battery power.

NOTE: As Operator faces the plug with the keyway at "9 o'clock," pin no. 1 (at 6 o'clock) is battery plus; pin no. 2 (at 12 o'clock) is blank; pin no. 3 (at 3 o'clock) is ground (minus).

Plug No. 2: Three-pin Tuchel plug is a parallel battery-power outlet. It can be tapped to run auxiliary equipment off battery power. If either plug no. 1 or the Cannon input are unusable, plug no. 2 can be used to supply power to the camera.

NOTE: As Operator faces the plug with the keyway at "9 o'clock," pin no. 1 (at 12 o'clock) is blank; pin no. 2 (at 3 o'clock) is ground (minus); pin no. 3 (at 6 o'clock) is battery plus.

Plug No. 3: Five-pin Tuchel for sync pulse.

NOTE: As Operator faces the plug with the keyway at "9 o'clock": pin no. 1 (at 11 o'clock) is ground (minus); pin no. 2 (at 1 o'clock) is the AC pulse for the sound recorder; pin no. 3 (at 3 o'clock) is the scene-marking oscillator (pulse for "beep" on recorder); pins no. 4 (at 5 o'clock) and no. 5 (at 7 o'clock) are connected in the cable and provide power for the camera lights. The lights will *not* work until the cable is plugged into the camera.

Plug No. 4: The top four-pin Tuchel plug is a blank on most cameras. It can be wired for special applications. If the plug is custom wired, specific instructions must be obtained for its use.

Interior full-frame exposure bulb: In series with exterior bulb located near matte box; lights up as signal is registered on film.

To change full-frame exposure bulbs: Rotate exterior plastic bulb housing counterclockwise to remove housing (use a rubber band as a grip on the plastic), pull bulb out with tweezers (a black tube with a bulb at the other end will emerge). Replace *both* bulbs and reinsert in camera. Rotate plastic housing clockwise.

CAUTION: If bulb rod (the black tube) is removed from the camera, cover the bulb socket with black tape to prevent a light leak into the camera.

Interior edge-marking bulb: In series with exterior bulb; located at rear of camera.

To change edge-marking bulbs: (a) Interior bulb: remove slotted screw at base of camera, and remove bulb with tweezers. Insert new bulb, and replace screw. (b) Exterior bulb: rotate plastic housing counterclockwise (use a rubber band as a grip on the plastic), unscrew bulb, and insert a new one. Replace cap.

NOTE: In regard to the full-frame and edge-marker bulbs: *always* replace *both* bulbs in series. Since the life expectancy of each bulb is approximately the same duration, two fresh bulbs will eliminate alternate burnouts.

10.9d Turret: Three-position; 21° divergent ports.

To rotate: Grasp turret grip opposite taking lens. Depress (or lift) until desired lens rotates into position nearest the contour grip at the right side. Turret snaps into place.

NOTE: Turret grips have indented data marks which are visible to the Operator and help him to determine which lens is in the "taking" position, i.e., the widest-angle lens, one dot; the normal lens, two

dots; and the telephoto lens, three dots. Each lens should be mounted opposite the data mark to which it corresponds.

10.9e Lenses

To mount on turret: Rotate lens barrel until channel in the mount aligns with the infinity mark on the lens. Grasp lens by its knurled footage ring. Squeeze locking levers at each side of the lens port on the turret and insert the lens into port with the follow-focus grips ("wings") *up*. Slide the channel at rear of the mount over guide key inside the lens port. Release the locking levers. Gently tug at lens to make certain the levers have gripped the channel at rear of lens mount.

NOTE: Lenses should correspond as closely as possible to data marks on the turret grips.

To remove lens: Rotate follow-focus grips *up*. Grasp knurled footage ring. Squeeze locking levers at each side of lens port and gently pull lens away.

CAUTION: When using fewer than three lenses, always plug the empty port(s) to avoid light leak to the aperture.

NOTE: 16mm and 35mm Arriflex lenses are interchangeable with the following *exceptions:* 5.7mm, 10mm, 11.5mm, 16mm, and 25mm. These will *not* "cover" a 35mm aperture. The only wide-angle lenses that *will* "cover" a 35mm aperture are: 9.8mm, 14.5mm, 18.5mm retrofocus, and the 28mm *made for the 35mm cameras.*

10.9f Viewfinder: Reflex. Image magnified 10×.

To align reflex mirror for viewing: Rotate inching knob at rear of motor.

To detach eyepiece: Rotate knurled eyepiece coupling nut on finder clockwise and pull eyepiece from keyed slots.

Hinged metal cap: Closes viewing system. This cap must be closed when Operator's eye is not covering the eyepiece so that stray light cannot strike mirror and "kick back" onto film.

To focus: Rotate narrow scalloped ring on eyepiece clockwise to the word "lose" (loose). Rotate large scalloped ring nearest the eyecup to focus on the groundglass. When focus is set, turn the narrow ring counterclockwise to "fest" (tight).

Groundglass: Behind eyepiece. Views full aperture. Cannot be changed on the job.

To clean: Remove eyepiece to expose the smooth surface of the groundglass.

10.9g Sunshade/matte box:

Either end of sunshade/matte box slides in and out on square boom.

To mount: Insert notched plate at rear of boom into shoe on camera housing above turret. Rotate knurled knob at front of boom until locking pin engages centering hole of shoe.

10.9h Filters

Holders (with retaining springs) house two 2 × 2 in. glass filters,

or two 2 × 2 in. gelatines (which slide into a separate gel frame). The gel frame clips into the holder.

NOTE: The rear filter housing rotates. The threaded opening at the rear housing accepts an adapter to hold a Series 8 glass filter.

To insert filter: Slide two "keyed" filter holders into left side of the matte box. Spring catch of housing must engage notch in holder.

To disengage filter holders: Depress catch at bottom right of matte box and slide the holder out.

10.9i Door: Hinged at front.

To open: Slide knurled latch (below viewfinder tube) forward. Swing eyepiece in a horizontal plane away from camera.

To close: Swing eyepiece toward camera. Slide knurled latch toward rear.

10.9j Magazines: 200-ft, 400-ft, 1200-ft.

To mount:

1. Depress spring lock lever at side of magazine lock. Rotate lock (at front left) counterclockwise until it clicks open. Remove dust cover. 2. Insert film loop into camera cavity. Seat rear male dovetail of magazine into rear female dovetail on camera housing. Lower the front male dovetail into the camera housing.

NOTE: Gears of the camera are spring-loaded and automatically engage gears of the magazine.

3. Rotate magazine lock clockwise.

CAUTION: Hand tighten only.

4. Thread camera (Sec. 10.9k).

To remove magazine: Remove film from gate and depress spring lock lever. Rotate magazine counterclockwise until it clicks open. Remove magazine.

10.9k Threading (Fig. 10-18)

1. Push pressure-pad catch toward camera interior wall and swing the hinged pressure pad open. 2. Rotate inching knob until single registration pin retracts from gate and single pulldown claw is withdrawn from gate. 3. Insert film into gate. Hold film with thumb and forefinger so as to adjust film up or down in gate. Clear lower loop from the guide track at the bottom of the film chamber (this should clear when the pulldown claw is at its lower point of travel). Upper loop will form automatically. 4. Rotate inching knob until registration pin enters gate and engages perforation. Close pressure pad with forefinger.

CAUTION: It is extremely important to engage the pressure pad catch. Double check after each closing.

5. Rotate inching knob and check that lower loop clears guide track. Adjust if necessary by repeating steps 3 and 4. Transport a few inches of film through the gate manually. If satisfactory, proceed to step 6.

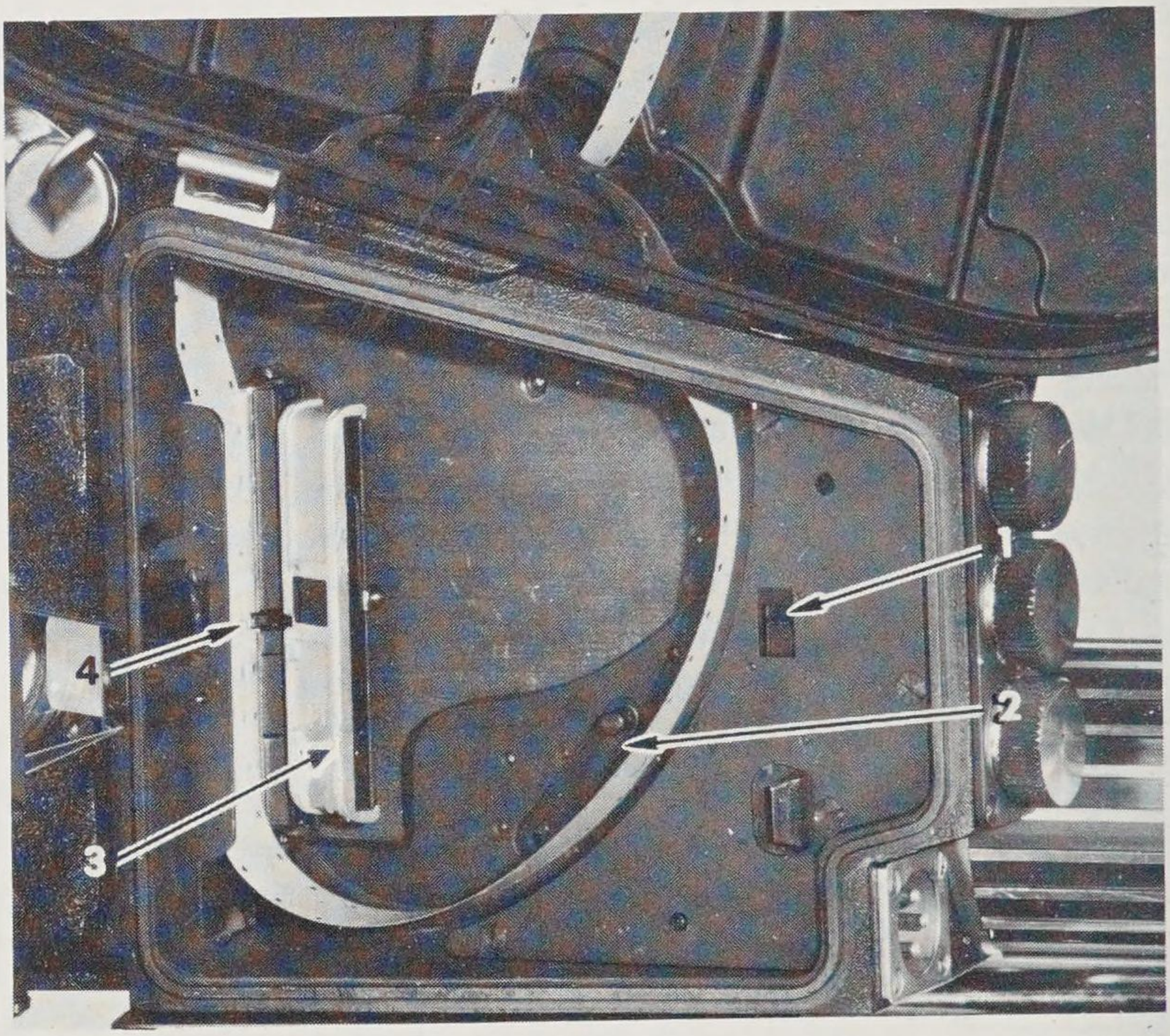

Fig. 10-18. Arriflex 16M threading detail. Courtesy of Arnold & Richter K. G.

1. Internal ON/OFF switch
2. Buckle-trip
3. Pressure pad (open)
4. Pulldown claw

6. Depress internal ON/OFF switch in camera. Observe action of film. If satisfactory, close door and zero the footage counter.

10.9l Buckle-trip

Located above lower guide track (Fig. 10-18). The roller on the arm cuts out power when pulled up by a short lower loop. It also prevents film end from running through the gate.

To reset: Open or close camera door. Buckle-trip resets automatically. The 16M has *no* override such as the 16S has.

10.9m Footage and frame counters: Located at back of camera above motor. Additive.

Footage counter: Registers 0–999 ft in increments of 1 ft, then reverts to zero.

Frame counter: Registers 0–39 frames in increments of 1 frame, then reverts to zero.

To reset: Rotate single disc at right of counter.

10.9n Tachometer

At back of camera above footage and frame counters. Registers speeds from 0–50 fps, in increments of one frame per second.

CAUTION: Camera is not governor controlled. A variable-speed motor *can and will* run faster than 50 fps. It cannot be assumed that by arbitrarily turning the rheostat so that the needle registers 50, the camera is running at 50 fps. Incorrect exposure can result if the camera speed is not deliberately and conscientiously set by the Cameraman.

10.9o Shutter: Nonadjustable. Equivalent to 180°.

10.9p Lubrication (Fig. 10-19)

Manufacturer recommends six to eight drops of oil on the following parts every 30,000 ft:

1. Depress top ball bearing oil valve near the center of camera interior to lubricate intermediate counter gear. 2. Depress ball bearing oil valve near film gate to lubricate intermediate shutter gear.

CAUTION: Manufacturer warns that oiling too frequently and/or excessive oil can damage the camera mechanism.

10.9q Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

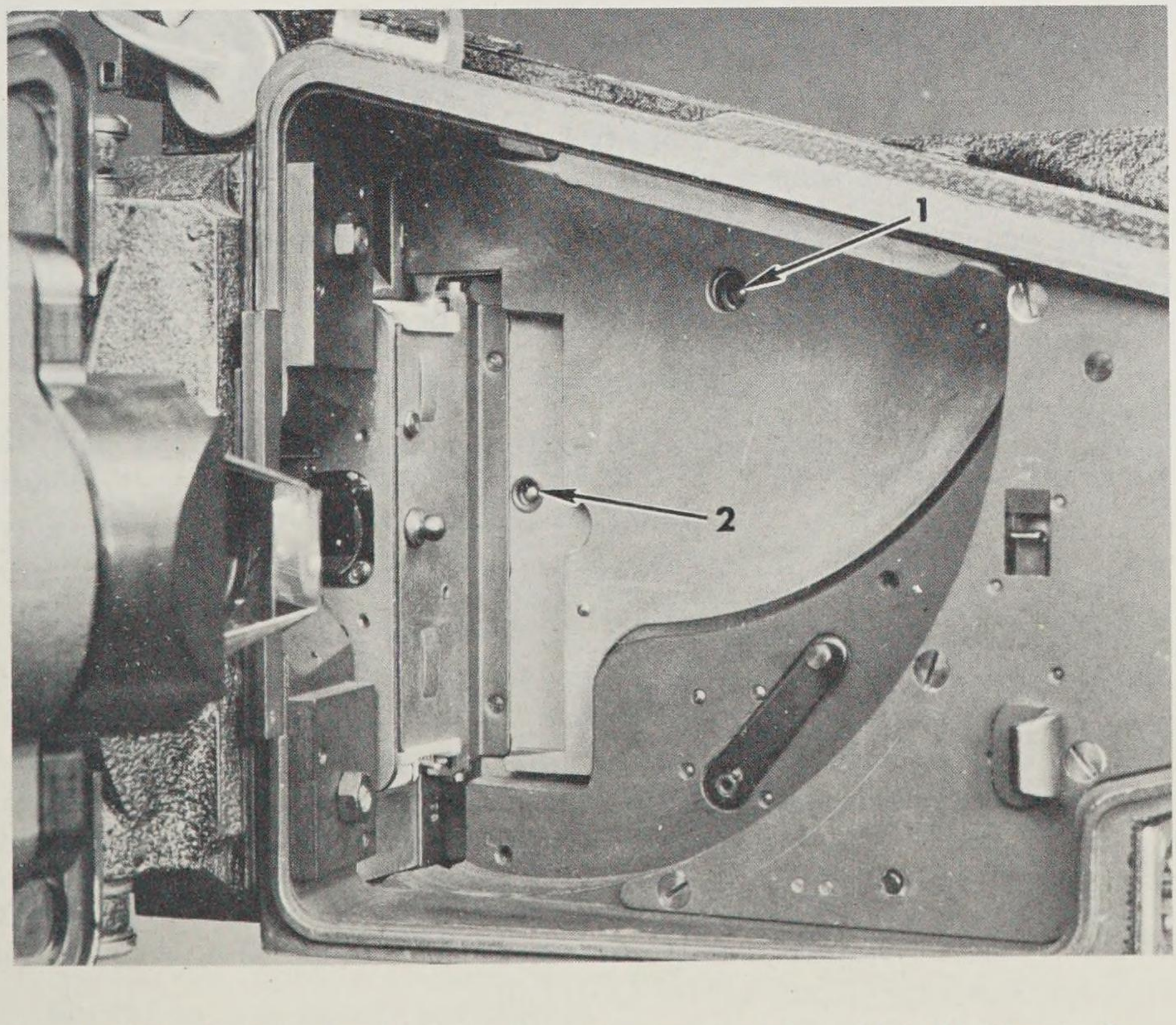

Fig. 10-19. Arriflex 16M lubrication. Courtesy of Arnold & Richter K. G.

1. Intermediate counter gear
2. Intermediate shutter gear

1. Open pressure pad and check the plate and pad for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

10.9r Weight: (with 400-ft load) 14-1/2 lb.

10.9s Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Battery connections loose; battery dead; motor not making contact; buckle-trip not reset
Intermittent starting and stopping	Slotted power-line prongs in battery squeezed together, making poor contact; lugs in battery loose; broken connection in power line
Torn perforations; ripped film	Improper threading
Door will not close	Camera "ON" switch depressed; dirt or film chip in door recess
Viewing system blacked out	Shutter closed; eyepiece cap closed; lens stopped down past *f*/22; lens cap on
Lens will not focus	Lens not seated; camera too close for minimum distance of lens; elements damaged
Cut-in on groundglass (wide-angle lens)	Viewing mirror "sees" aperture of lens, but camera aperture does not—no problem if turret is seated properly
Cut-in on groundglass (normal lens)	Turret not seated; matte box extended
Lens will not enter port	Guide key inside turret bent up or down, therefore will not enter lens channel
Film does not take up in magazine	Magazine take-up spindle loose; film loose on take-up core

10.10 ARRIFLEX 16M MAGAZINES (Fig. 10-20)

10.10a Type: Displacement.

10.10b Capacity: 400-ft (shown) and 200-ft (not shown).

10.10c Lid

One. 400-ft lid is lug- and dog-locked. 200-ft lid is hinged at top.

To remove: Depress safety spring in lid recess. Rotate lock bar counterclockwise (from "C" to "O"). Lift.

10.10d Feed: Left side. Film (wound emulsion in) pulls off spindle clockwise.

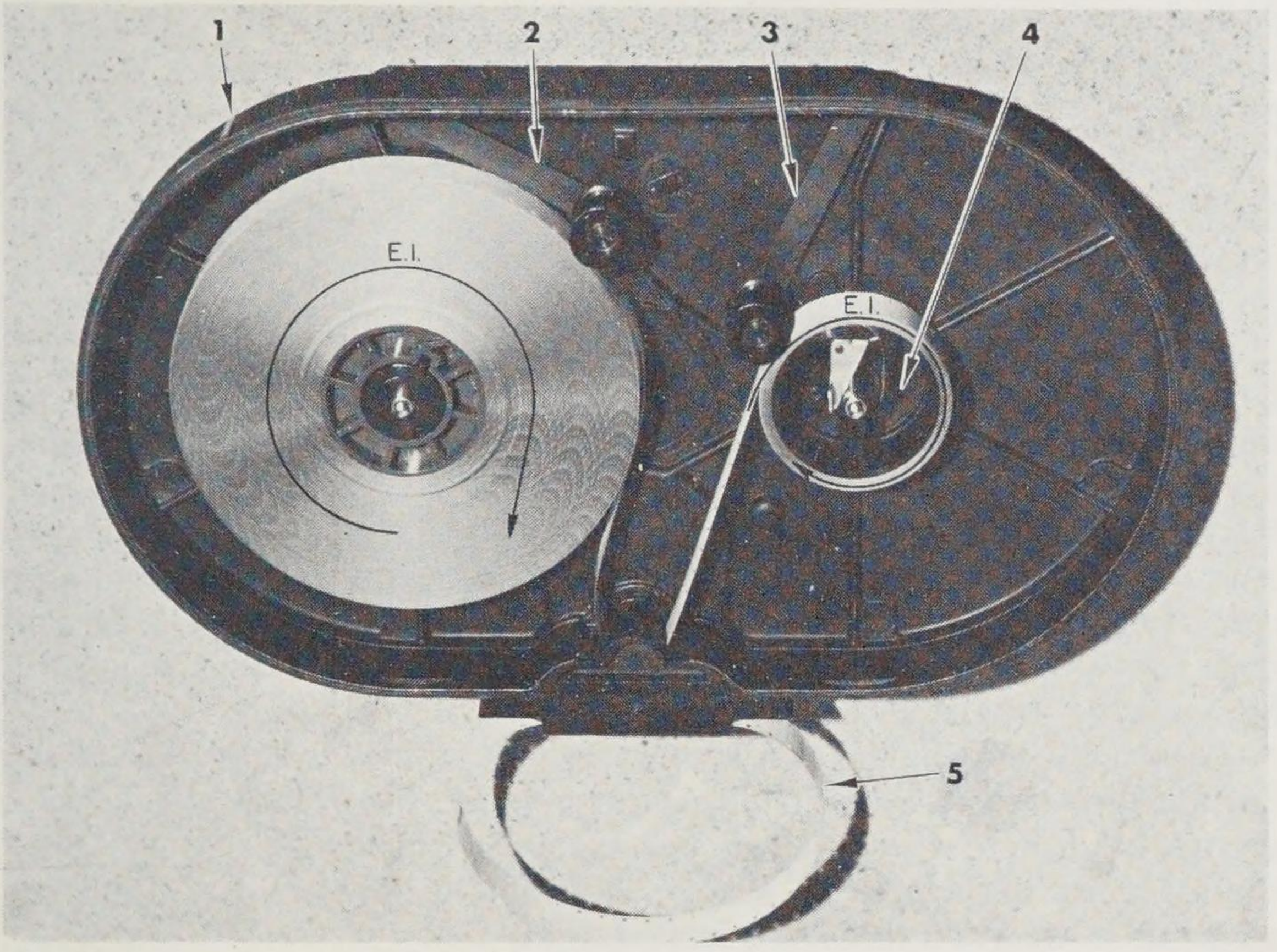

Fig. 10-20. Arriflex 16M 400-ft magazine. Courtesy of Arnold & Richter K. G.

1. Marking rib
2. Footage counter/roller-guide arm
3. Take-up roller arm
4. Collapsible take-up core
5. 36-perforation loop

10.10e Take-up: Right side. Film winds on spindle clockwise, emulsion always in.

10.10f Loading

1a. *400-ft magazine:* Remove lid. Swing footage-counter/roller-guide arm *up* and lock into catch near top of magazine. Swing take-up roller-guide arm up and lock into catch below the counter arm roller. 1b. *200-ft magazine:* Raise lid. Swing both footage-counter and take-up roller-guide arms toward center of magazine and lock into catches. 2. In darkness, remove film roll from can and bag. Insert film end into left side of magazine throat, slowly rotating gear at bottom clockwise with thumb until gear in throat engages film perforation. Thread at least 6 in. through.

NOTE: To expedite engagement of film in the magazine gears, cut the film so as to bisect a perforation.

3. Place film roll on the feed spindle. Rotate knurled feed-spindle wheel until spindle key engages the core keyway. 4. Rotate gear until film

end extends clockwise around the left outer edge of the magazine to the marking rib (a raised bar on the outside of the magazine). 5. Hold gear. Bring film end back counterclockwise, and then insert end into right-hand channel of magazine throat. Rotate gear until perforation engages gear and film moves into magazine.

CAUTION: It is important to maintain the proper loop size: 36 *visible* perforations. Do not allow excess film to exit feed side while trying to engage perforation of film end into the take-up gear!

6a. *When magazine has a collapsible take-up core:* Insert film end into slot of collapsible take-up core. Move clamp inward to secure film. 6b. *When magazine has a plastic core:* Place core on take-up spindle. Rotate knurled take-up–spindle wheel until spindle key engages the core keyway. Insert film end into core slot and wind film onto take-up core clockwise (emulsion in). 7. Release take-up roller-guide arm, and then footage-counter/roller-guide arm, making certain that film rides between the flanges of the roller guides.

To replace 400-ft lid: While holding lid at a 45° angle, insert the bottom lugs into mating slots in the magazine, then lower the lid to a secure fit. Rotate the lid lock bar clockwise from "O" to "C" until the safety spring snaps up. Pull on lid and run fingernails around the edge slit to ascertain that lid is locked tight.

To take out film slack: Rotate knurled spindle wheels at back of magazine. Feed rotates clockwise, take-up rotates counterclockwise.

To load daylight spools: Depress center of core spindles. Remove core holder and collapsible core. Place spools on square driver pins of spindles. Swing take-up and feed roller-guide arms *up* and lock into catches.

Film-loop guard: Depress film loop against magazine mouth. Slide loop guard (with notch inward) over film and under retaining plate.

10.10g Unloading: In darkness, remove magazine take-up lid.

When magazine has a collapsible core: Disengage clamp on core (push outward). Place index finger in core space, thumb on edge of roll. Turn magazine over and let film drop into the hand. Place exposed roll in bag and can.

When magazine has a plastic core: Place index finger on core, thumb on edge of roll. Turn magazine over and let film drop into the hand. Place exposed roll in bag and can.

10.10h Footage counter

At back of magazine. Subtractive; 500–0 ft in increments of 20 ft.

NOTE: The 400-ft magazine will run forward and reverse. The 200-ft magazine will run forward only.

10.11 ARRIFLEX 16M 1200-ft MAGAZINE (Figs. 10-21, 10-22)

10.11a Type: Coaxial.

10.11b Capacity: 1200-ft.

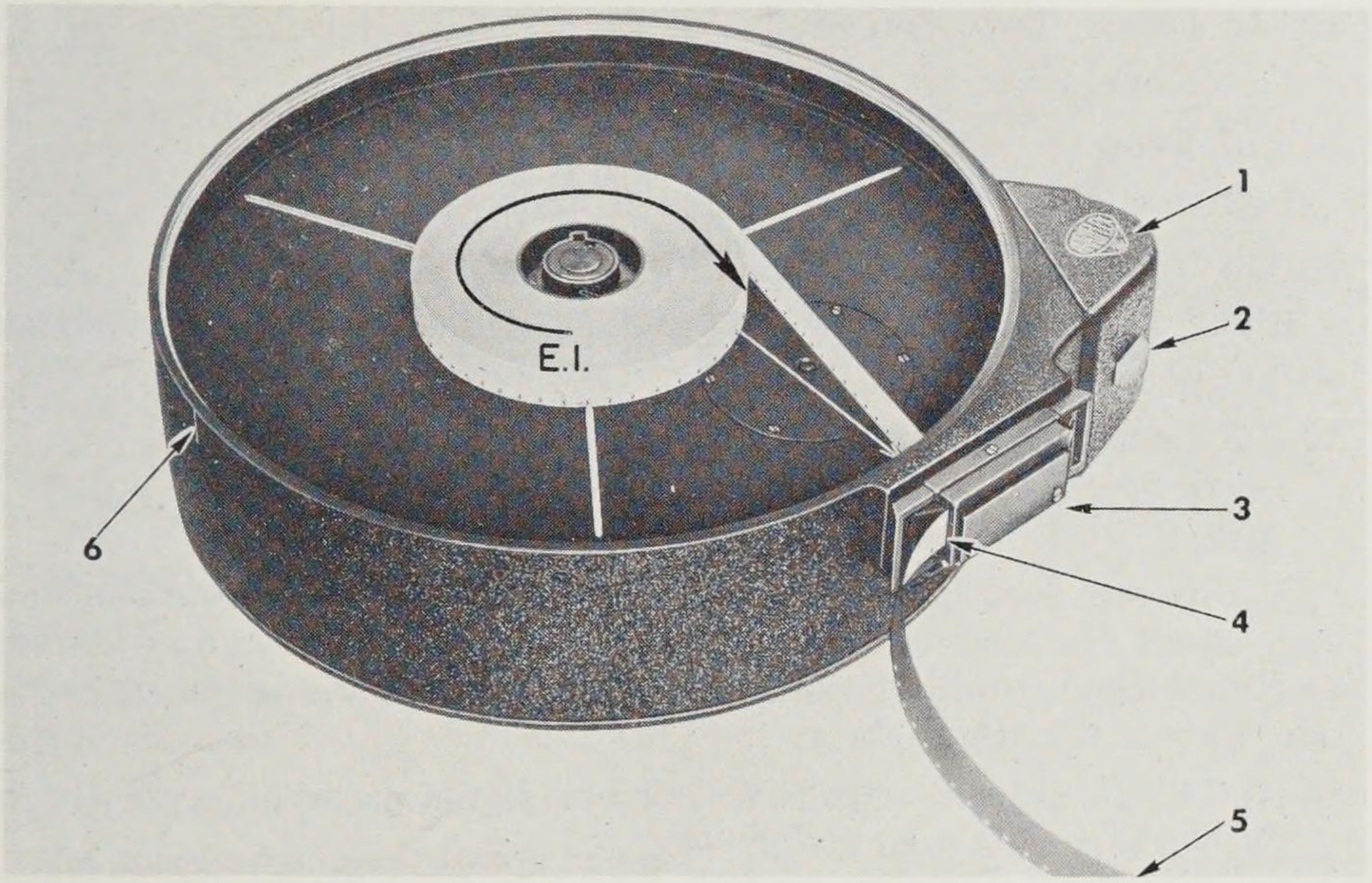

Fig. 10-21. Arriflex 16M 1200-ft magazine feed side. Courtesy of Arnold & Richter K. G.

1. Crossover chamber (closed)
2. Chamber latch
3. Gears (not visible)
4. Feed throat
5. Extend film end to marking rib
6. Marking rib

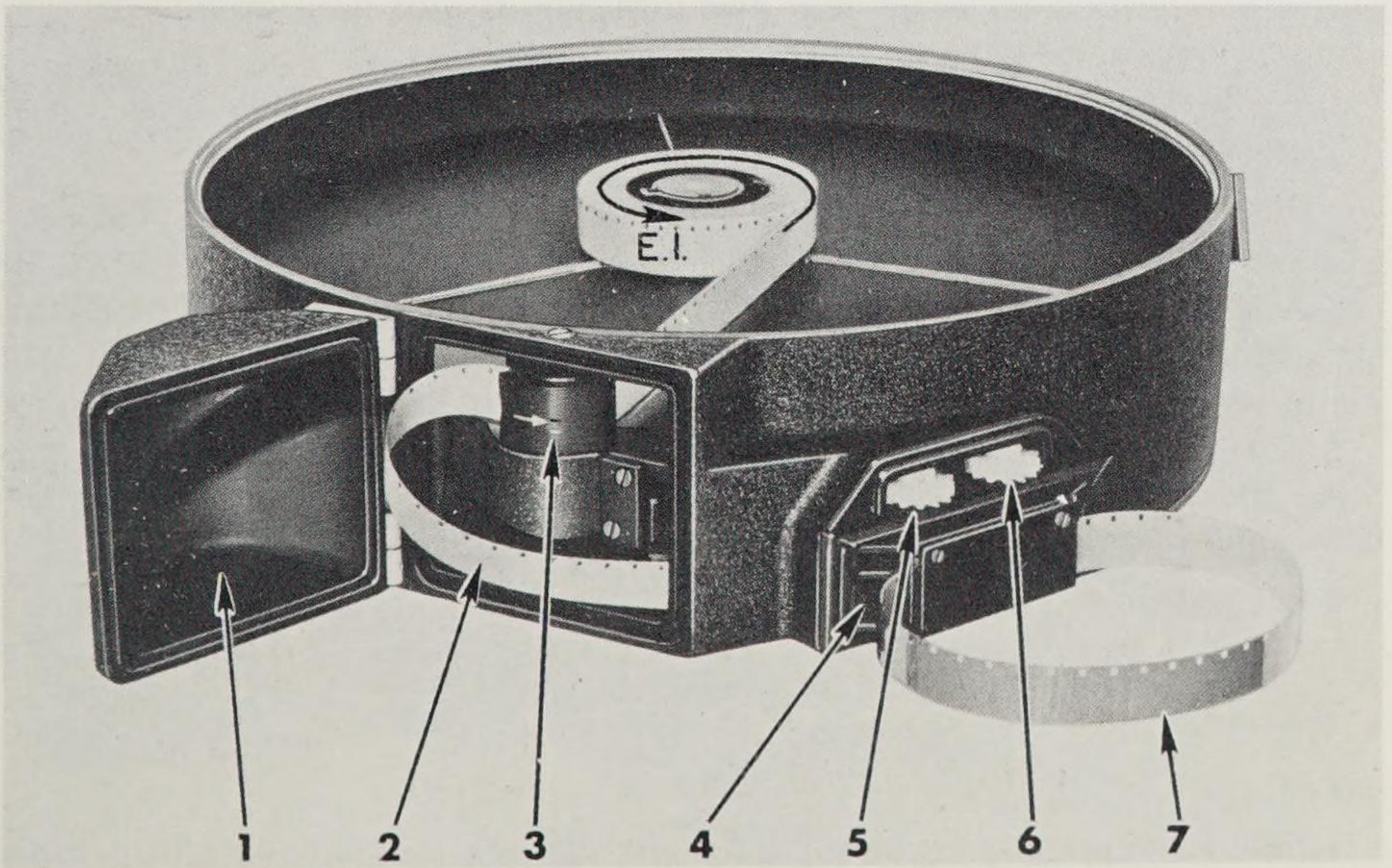

Fig. 10-22. Arriflex 16M 1200-ft magazine: crossover loop and take-up side. Courtesy of Arnold & Richter K. G.

1. Crossover chamber (open)
2. Approximately 19 perforations visible
3. Crossover chamber sprocket
4. Take-up throat
5. Take-up gear
6. Feed gear
7. 36-perforation loop

10.11c Lids: Two. Threaded.

To remove: Unscrew counterclockwise; lift.

10.11d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

10.11e Take-up

Right side. Film winds on spindle counterclockwise, emulsion always in.

10.11f Loading

NOTE: Feed compartment is *up* when crossover chamber is at loader's right.

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Insert film end into feed throat, slowly rotating gear at bottom counterclockwise with thumb until gear in throat engages perforation. Thread 6 in. through.

NOTE: To expedite engagement of film in the magazine gears, cut the film so as to bisect a perforation.

3. Place film roll on feed spindle, making certain spindle key engages the core keyway. 4. Replace feed lid. 5. In light: rotate gear until film end extends to marking rib (raised bar on the outside of magazine). 6. Hold gear. Bring film end back counterclockwise, then insert end into right-hand (take-up) channel of magazine throat. Rotate gear until perforation engages gear and film moves into magazine.

CAUTION: It is important to maintain proper loop size: 36 *visible* perforations. Do not allow excess film to exit feed side while trying to engage perforation of film end into the take-up gear!

7. Push back on crossover chamber latch and open crossover chamber. Rotate gear until film end enters crossover chamber and touches its open cover (approximately 19 perforations will be visible). 8. Turn magazine over so that the crossover chamber is at the loader's left. Unscrew the take-up lid. Insert film end into the crossover chamber sprocket, and rotate the gears until a sufficient amount of film enters the take-up chamber to be wound on the take-up core. 9. Close crossover chamber and secure cover firmly.

CAUTION: *Do not reopen* the crossover chamber cover in light *after* film has been *exposed and taken up* into the magazine. The passageway between the chamber and the take-up compartment is *not light-tight* when the cover is open.

10. Replace take-up lid.

Film-loop guard: Depress film loop against magazine mouth. Slide loop guard (with notch inward) over film and under retaining plate.

10.11g Unloading

In darkness, unscrew take-up lid. Place index finger in core space, thumb on edge of roll. Turn magazine over, remove film. Place exposed film in bag and can.

10.11h Counter: None.

10.12 ARRIFLEX 16 BLIMP (Figs. 10-23, 10-24, 10-25)

NOTE: All directions are from the Operator's point of view.

NOTE: Most of this section pertains to the fiberglass blimp. We recognize, however, that many aluminum blimps are currently in use. Thus while information in this section applies to both models, specific differences are noted under sections entitled "Aluminum Blimp." Most notable exceptions are listed under Secs. 10.12e ("Power Line"), 10.12f ("Sunshade"), 10.12g ("Coupling Alignment"), and 10.12h ("Filters"). The aluminum blimp accepts only the 16S camera; the fiberglass blimp accepts either 16S or 16M cameras and features other mechanical and electrical improvements.

10.12a Base

Bottom fitted with two ⅜"-16 tapped holes to accommodate tripod lockdown screw.

10.12b Camera preparation

Eyepiece: Remove from camera. Place prismatic double-elbow assembly (periscope) on camera. Attach camera eyepiece to viewfinder extension tube and insert unit into blimp extension tube access hole. To secure, rotate clockwise the knurled lock nut on the pressure lock.

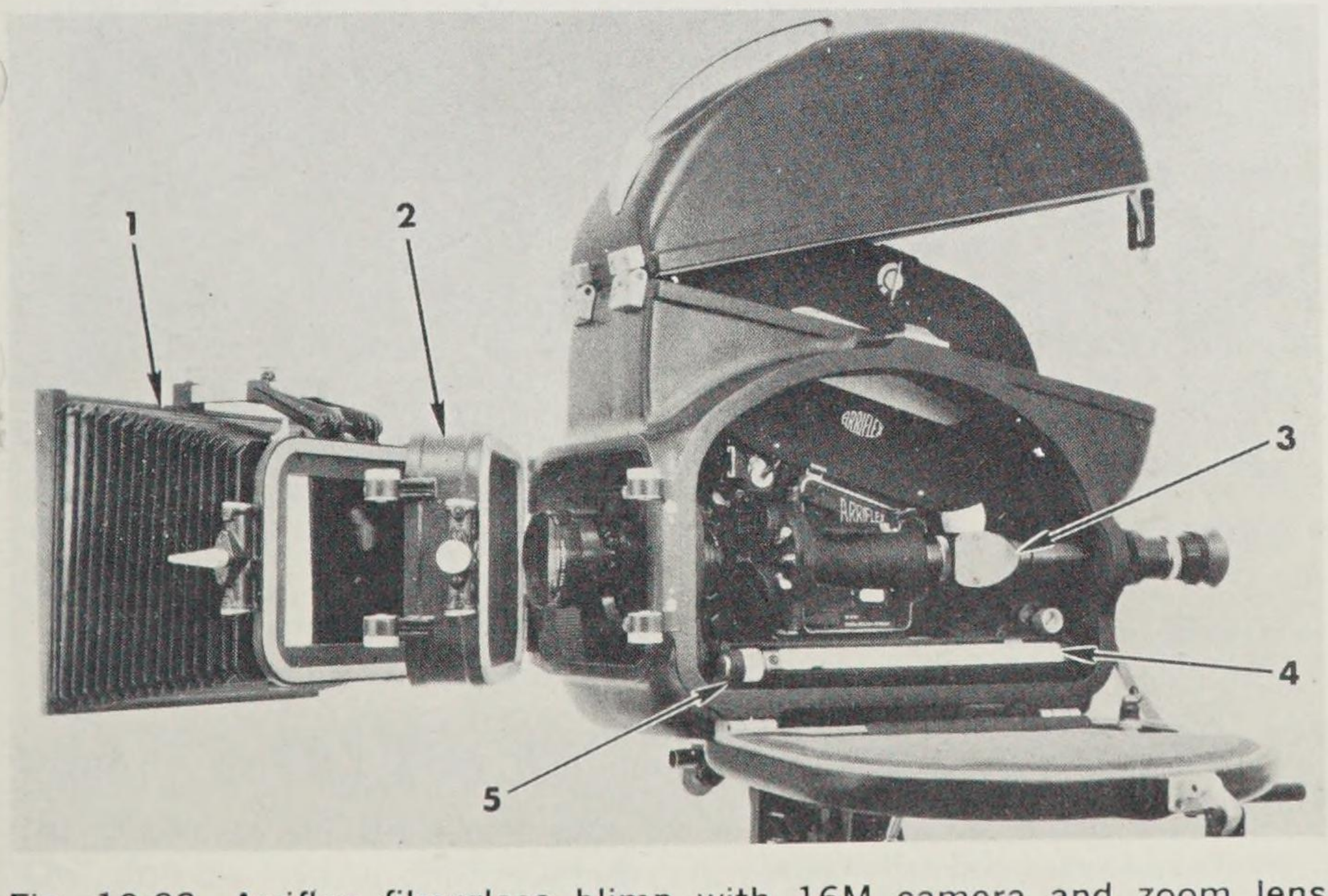

Fig. 10-23. Arriflex fiberglass blimp with 16M camera and zoom lens extension. Courtesy of Arnold & Richter K. G.

1. Matte box
2. Zoom-lens door extension
3. Periscope
4. *f*/stop-focus-marking strip
5. Strip knurled ring

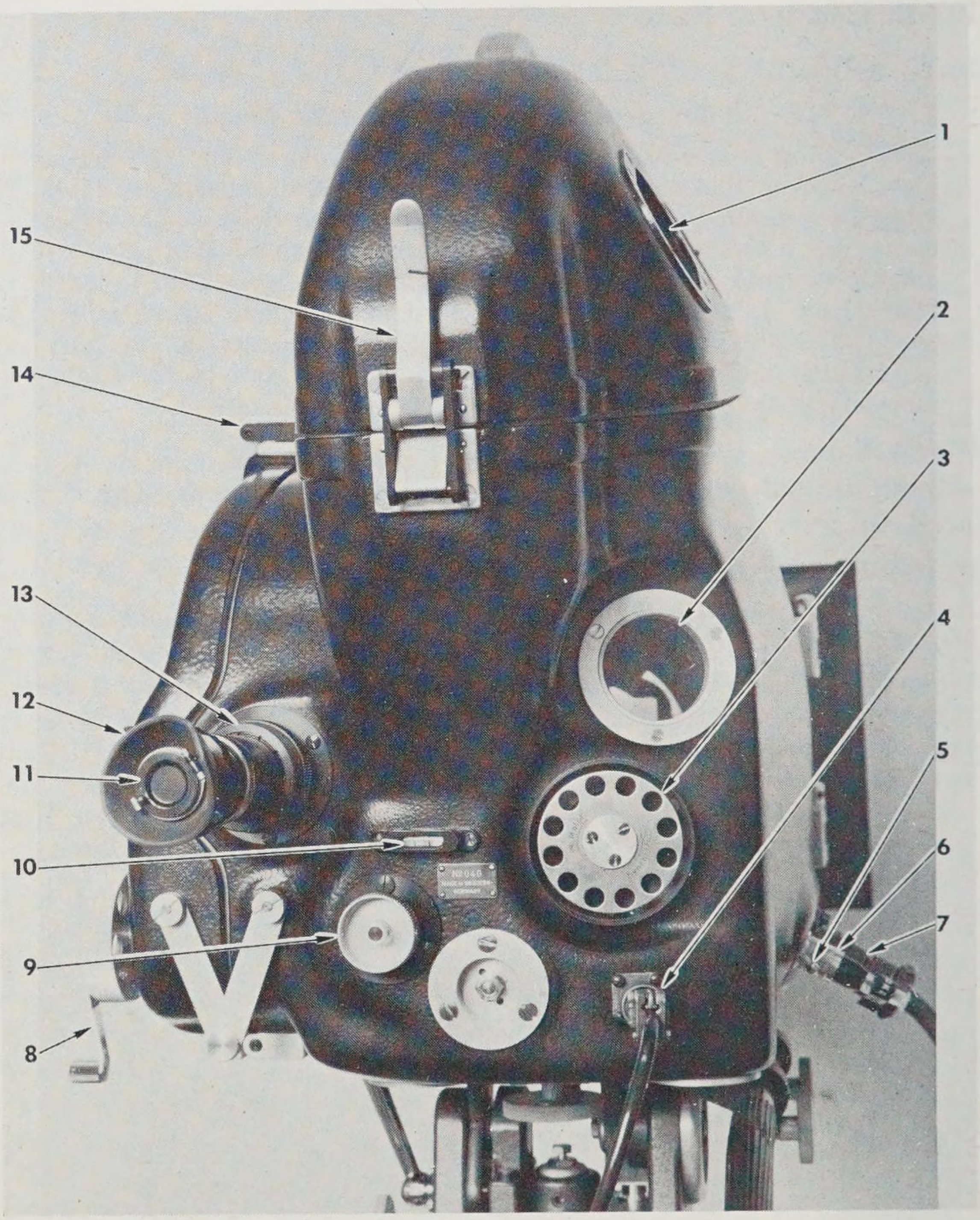

Fig. 10-24. Arriflex 16 fiberglass blimp (rear view). Courtesy of Arnold & Richter K. G.

1. Magazine footage counter window
2. Tachometer and counter window
3. Inching knob dial
4. ON/OFF toggle switch extension
5. ON/OFF toggle switch
6. Sync-pulse plug
7. Power plug
8. Focus knob
9. *f*/stop control
10. Bubble level
11. Light trap
12. Eyepiece
13. Lock nut
14. Camera access latch
15. Magazine access latch

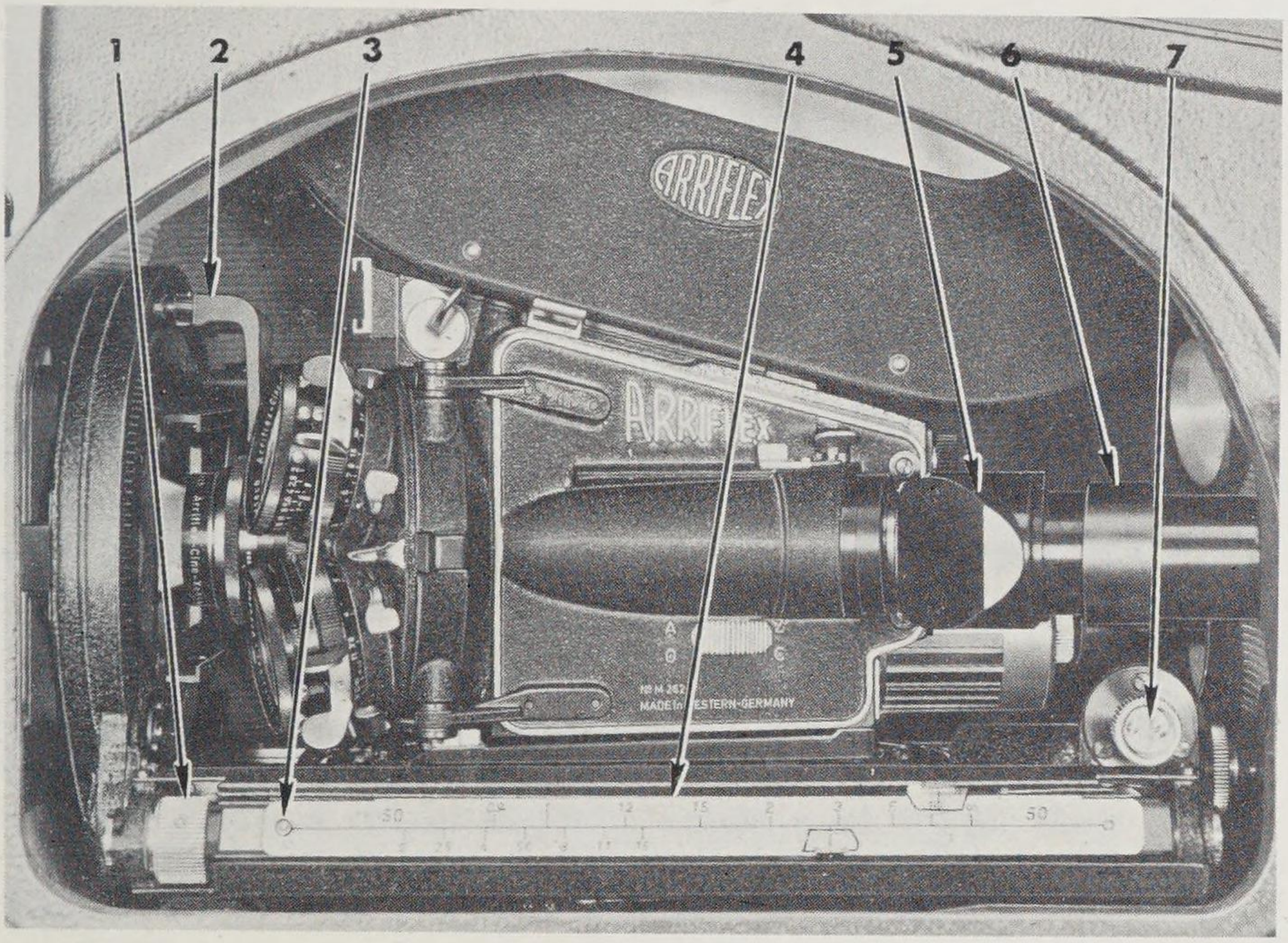

Fig. 10-25. Arriflex 16 fiberglass blimp (detail). Courtesy of Arnold & Richter K. G.

1. Marking-strip knurled ring
2. Focus bracket arm
3. Forward catch
4. *f*/stop-focus-marking strip
5. Periscope
6. Light-trap sleeve
7. Focus knob coupling

Motor: Remove variable-speed motor and replace with AC synchronous motor or DC governor-controlled (constant-speed) motor.

NOTE: Depending upon the type of motor in use, AC synchronous or DC governor-controlled (constant-speed) motor, the internal inching-knob *coupling* inside the blimp must be changed to fit the motor knob. A 1/8-in. hex wrench is necessary to change the coupling.

Detachable base plate: Remove from blimp and attach to bottom of camera.

CAUTION: The edge of the 16S base plate is straight. The edge of the 16M base plate is contoured. They are *not* interchangeable.

To mount base plate: Invert camera. Align base-plate screw with tapped hole in camera base, making certain the two locating studs on the plate are on the same side as the contour handgrip and motor. On cameras with a clockwise thread, rotate the inner flat screw head with the two-finger cutout. On cameras with a counterclockwise thread, rotate the outer knurled screwhead. Secure plate to the camera base, making certain the left front of the camera is flush with the alignment block of the base plate.

10.12c Access

To camera: Raise clamp on left side door and lower the door 90°.

To lenses: Rotate lever at left front of matte box glass door clockwise, swing open.

To magazine: Raise clamp at rear of blimp, lift top forward.

To change magazine access hood: Insert 3/16-in. rod or hex wrench into heads of hinge pins at front of door and unscrew. Replace with 1200-ft hood.

Aluminum blimp

To magazine: Lower the clamp at side of blimp to release; raise hinged top.

10.12d Camera insertion

1. Turn the two pressure locks (at front and back of inner frame) 90° to the frame. 2. Insert the camera, mounted on its base plate, *without a magazine*, into the blimp, keeping the camera tipped at a slight angle to clear the two *vertical* locating studs in the blimp frame (the unit the camera rests on). 3. Align and insert the two *horizontal* locating studs *of the base plate* (attached to the camera) into the mating retaining blocks above the right side of the blimp frame. 4. Lower the camera and engage the base-plate sockets onto the vertical locating studs in the blimp frame. 5. Rotate the two pressure locks (front one clockwise, rear one counterclockwise) to secure the base plate.

> NOTE: The clamp screw (located between the two horizontal base plate studs) must be adjusted so that the release button for the blimp-frame lock maintains the base plate rigid laterally.

6. Slide viewfinder extension tube (with camera eyepiece attached) into the extension-tube access hole. Place light-trap sleeve over the extension tube (inside the blimp).

> CAUTION: Extension tube should not touch the double prismatic assembly. Slide the light-trap sleeve forward to cover the space between the extension tube and the elbow assembly.

7. Rotate clockwise the knurled lock nut on the pressure lock (outside blimp) to secure the extension tube. 8. Mount the magazine on the camera through the magazine access hood.

10.12e Power line

Fiberglass blimp—external (shown): Four-pin Tuchel plug inserts into female receptacle at back of blimp below inching wheel. Extension of plug has an ON/OFF toggle switch in a box that clamps to the tripod handle (Fig. 10-24).

> NOTE: Depress ON/OFF switch on the camera to the ON position to run the camera from the blimp switch.

Power panel: At right side of blimp.

Synchronous-pulse plug: Recessed male five-pin Tuchel plug.

Power-supply plug: AC or DC; recessed male eight-pin Tuchel plug. The AC cable is fitted with a Tuchel plug at the power source

end and requires a step-down transformer in the line with its indicator set to FWD-110V. A DC cable is fitted with a standard two-prong battery connector plug.

Two fuses: In vertical alignment: the top fuse is for power; the bottom fuse for lights.

Aluminum blimp—external (not shown): One single-pole ON/OFF switch is at right rear of blimp.

NOTE: Camera ON/OFF switch must be depressed to ON position to run the camera from the blimp switch.

Power-supply plug: Recessed eight-pin Tuchel (AC or DC) below the ON/OFF switch. The AC cable requires a step-down transformer in the line with its indicator set to FWD-110V. A DC cable is fitted with a standard two-prong battery connector. A red light above the viewfinder glows when camera is running.

Fiberglass blimp—internal (not shown):

Internal lights: Located above the focus strip, lens aperture and focus, magazine footage counter, tachometer, and camera footage counter.

Synchronous pulse: Five-pin Tuchel plug inside rear of blimp is inserted into back of 16M camera.

Coupling for adapter cable: Six-pin plug inside front of blimp inserts into adapter cable.

NOTE: Depending on the camera being used, the adapter cable that is inserted into the six-pin plug coupling is fitted with either a 16M Cannon plug at the camera end or a standard two-prong 16S female plug at the camera end.

Aluminum blimp—internal (not shown)

To operate internal lights: Depress button above focus-strip port (left front of blimp). Internal lights are located above the focus strip, lens aperture and focus, tachometer, and camera footage counter.

Adapter cable: Fitted with a standard two-prong 16S female plug at the camera end.

NOTE: No synchronous-pulse connection, unless customized.

10.12f Sunshade

Fiberglass blimp (shown)

To mount: Insert boom into bracket at front of lens access door. Bottom of bellows slides into two holders on lens access door to secure bottom. At top of bellows, two hooks insert into the lip of the lens access door to secure the top. Bellows moves in and out by loosening the knurled knob in the bracket that holds the boom.

Aluminum blimp (not shown)

To mount: Raise the upper knurled lock nut at the front of lens door. Lower the bottom lock nut. Align slots at the rear of sunshade housing with the lock-nut brackets. Lower the upper lock nut and raise the bottom lock nut, and secure sunshade to lens door. Bellows moves in and out on two rods. Tighten knurled lock screw on each rod to secure.

10.12g Coupling alignment

Fiberglass blimp (shown)

Focus and f/stop marking-strip indicators: At base of inner frame. Indicators are visible through left door port.

The focus indicator is at the top and should be rotated to the rear to set for infinity.

The *f*/stop indicator is at the bottom and should be rotated forward to set for the widest opening of the lens.

To insert strip:

1. Open camera access door. Place small hole of the marking strip over the rear catch. 2. Push the forward catch (at front of strip recess) toward the rear. Place the large hole of the strip over the forward catch; release.

Knurled ring: Located forward of the scale strips. Unit rotates counterclockwise to bring one of three scale strips into viewing position (one strip for each lens on the turret).

> NOTE: The strips may be calibrated in ink (by the manufacturer) with *f*/stops (or T stops) and distance scales for individual lenses, or they may be blank.

To mark blank strips for f/stop: Couple lens to *f*/stop knob (see "*f*/stop scale," below). Set lens at widest opening. Make pencil mark on strip above *f*/stop-scale indicator. Set stop at each aperture setting on lens barrel and transcribe each setting to the marking strip.

At right side of strip, write focal length of the lens for which the strip has been marked.

To mark blank strips for focus: Couple lens to focus knob (see below, "Standard Lenses"). Set lens at infinity. Make infinity pencil mark (∞) on strip below footage indicator. Set focus at each footage indication on the lens barrel and transcribe each mark to the marking strip. At right side of strip, write focal length of the lens for which the strip has been marked.

To couple lens and f/stop:

Marked strips: Be certain the focal length of the lens, indications on the lens, and marking indicator agree. (An indicator that is out of alignment can be adjusted by sliding it on the support wire.)

f/stop scale: Rotate *f*/stop control (the knurled knob at the back of the blimp below the bubble level) until the *f*/stop indicator (the lower one on the marking strip) is at extreme *front*.

f/stop drive arm: Rotate *f*/stop indicator forward (as above). Set lens to its widest opening. Lower *f*/stop drive arm so that spring tension of arm causes the lip to engage the diaphragm ring of the lens.

> CAUTION: Diaphragm of lens must agree with setting on the scale when coupled.

Standard lenses:

1. Rotate focus knob (in door below eyepiece extension tube) counterclockwise until the upper footage indicator is at extreme

rear (infinity). 2. Open lens access door. Set lens at infinity (wings aligned to the lens channel, i.e., up. 3. Insert rubber end of focus bracket arm between the "wings" of the lens. Secure bracket arm to the pilot pins on the outer focusing ring. Rotate knurled lockdown screw to secure.

Zoom lens: Use of a zoom lens necessitates the mounting of a door extension and using a lens-installation kit (an accessory of the blimp).

To add zoom-lens door extension (see Fig. 10-23):

1. Insert 3/16-in. rod or hex wrench into heads of hinge pins on lens access door and unscrew. 2. Insert zoom-door extension into hinges of blimp and secure with hinge pins. Rotate slotted knob to lock left side to blimp. 3. Insert lens access door into hinges of the zoom extension unit. Secure with hinge pins. Rotate lever counterclockwise to lock left side to extension unit.

Installation kit

To mount lens-support frame: Squeeze spring-loaded catch on frame and insert it into the filter-holder bracket (forward of the focus ring).

Support flap: Insert four retaining screws through the flaps into holes in the support frame to secure the flap in place.

To mount focus-control slip-on ring:

NOTE: This unit is installed before inserting the lens into camera turret.

Set lens at infinity. Place focus-control ring on lens focus barrel (forward of the lens focus mark) with female bracket facing *toward the camera*. Secure with two set screws.

To mount focus coupling arm:

NOTE: This unit is installed before inserting the lens into camera turret.

Secure arm on the inner *f*/stop ring inside the blimp *toward* the lens access door. Insert the arm into the focus-control slip-on ring.

To mount zoom-control slip-on ring:

NOTE: This unit is installed before inserting the lens into camera turret.

Set lens to longest focal length. Place the ring on the lens focal-length barrel (to the rear of the focal length marks) with the "wings" facing *toward the lens access door*. Secure with two set screws.

To mount zoom coupling arm:

NOTE: This unit is installed *after* inserting lens into camera turret.

Place rubber end of arm between the "wings" of the zoom-control slip-on ring. Secure arm to the outer focusing ring in the blimp *toward the camera*.

f/stop scale:

CAUTION: Stops must be set manually.

Aluminum blimp (not shown)

Focus marking-strip indicator: A straight line in the marking-strip viewing window at the left front of blimp.

To insert marking strip:

1. Open lens access door and place the long hole of the marking strip over the catch on the lens gear housing. 2. Wrap strip around the lens gear housing. Push the spring-loaded catch *up*. Place small hole of the strip over the spring-loaded catch. Release.

To scribe footage marks on marking strip: Open camera access door and insert a pencil into the notch inside blimp at the left of lens gear ring.

To mark blank strips: Couple the lens to the focus knob (see below, "Standard Lenses"). Set lens at infinity. Scribe infinity pencil mark (∞) on strip. Set focus at each footage indication on lens barrel and transcribe each setting to the marking strip. At bottom of strip write the focal length for which the strip has been marked.

f/stop scale: None. The *f*/stops must be set manually. A mirror on a bracket is inserted into the camera matte-box shoe which permits viewing of the *f*/stop.

Standard lenses:

1. Open lens access door and set taking lens at infinity. Rotate lens gear in the lens access door and align the two dots (one in the door, one on the gear).

> CAUTION: Be certain the rubber end of the spring-tension focus-bracket arm (on the lens gear) is *up* before aligning the dots.

2. Close and lock the lens access. Reach through the side door and depress the rubber end of the focus bracket arm into "wings" of the lens.

Focus knob: Scalloped knob at left front of the blimp is automatically coupled to the rear focus knob so that the Operator can focus.

f/stop drive: None.

Zoom lens: No zoom lens can be installed unless the blimp has been customized, in which case the zoom lens is usually a permanent installation.

10.12h Filters

Fiberglass blimp (shown): Utilizes a filter holder. The holder swivels; a pressure snap keeps the holder in place. A single glass 3 × 3 in. filter slides into the holder from the left side.

To mount: Open lens access door. Depress spring-loaded catch on the holder and slide the filter into the bracket.

Aluminum blimp (not shown): The 3 × 3 in. filter mounts against glass of lens access door and is held in place by four swivel locks.

10.12i Viewfinder/focus tube

To align reflex mirror for viewing: Place fingertips into recesses of "telephone-dial" inching knob at back of blimp below the tachometer viewing port. Depress and rotate to engage motor inching knob.

Eyepiece: Rotate narrow scalloped ring on eyepiece clockwise to the

word "loose." Rotate large scalloped ring nearest eyecup to focus on the groundglass. Turn narrow ring counterclockwise toward "fix" to secure.

Light trap: Hinged metal cap in eyepiece snaps closed to prevent stray light from striking the mirror and "kicking back" onto the film.

10.12j Ports

Fiberglass blimp (shown): Horizontal window at left side permits viewing of focus (distance) and *f*/stop scales. Tachometer and counter windows are at back of the blimp. Magazine footage-counter window is at right side of blimp hood.

Aluminum blimp (not shown): Vertical window at left side permits viewing of focus (distance) scale. Tachometer window is at back of blimp above "telephone dial." Second window at left of "telephone dial" permits viewing of footage counter. *No* window in magazine hood.

10.12k Weight: (Less camera.) Fiberglass blimp: 28-1/4 lb; aluminum blimp: 56-1/4 lb.

10.13 ARRIFLEX 16BL CAMERA* (Figs. 10-26, 10-27)

NOTE: All directions are from the Operator's point of view.

10.13a Base

Bottom fitted with two ⅜"-16 tapped holes to accommodate tripod lockdown screw.

> WARNING: Inserting a long tripod lockdown screw in either hole can accidentally activate the bypass (pistol-grip) ON/OFF switch and cause the camera to run. A thin strip of cardboard placed between the camera base and the tripod head plate will eliminate the problem.

10.13b Motors

To mount:

1. Remove the four exterior screws and detach the motor-housing cover (see Fig. 10-27) at right side of the camera. 2. Open camera door and remove the two internal screws and plastic housing cover from the transfer gear (see Fig. 10-28). 3. Remove the motor pinion from the motor-drive shaft. Insert motor into motor socket, aligning multipin connector. Press in until motor is firmly seated. Secure motor with the three internal motor mounting screws by inserting them into the motor from *inside* the camera. 4. Secure the motor pinion to center of drive shaft. Replace plastic housing inside camera. Replace motor housing cover at right side of camera.

NOTE: BL motors are not interchangeable with S- or M-type motors.

To set FWD/REV switch on constant-speed motor: Unscrew plastic cap at rear of motor housing cover and slide switch to the left for

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*Manufacturer states the designation "BL" is for blimped.

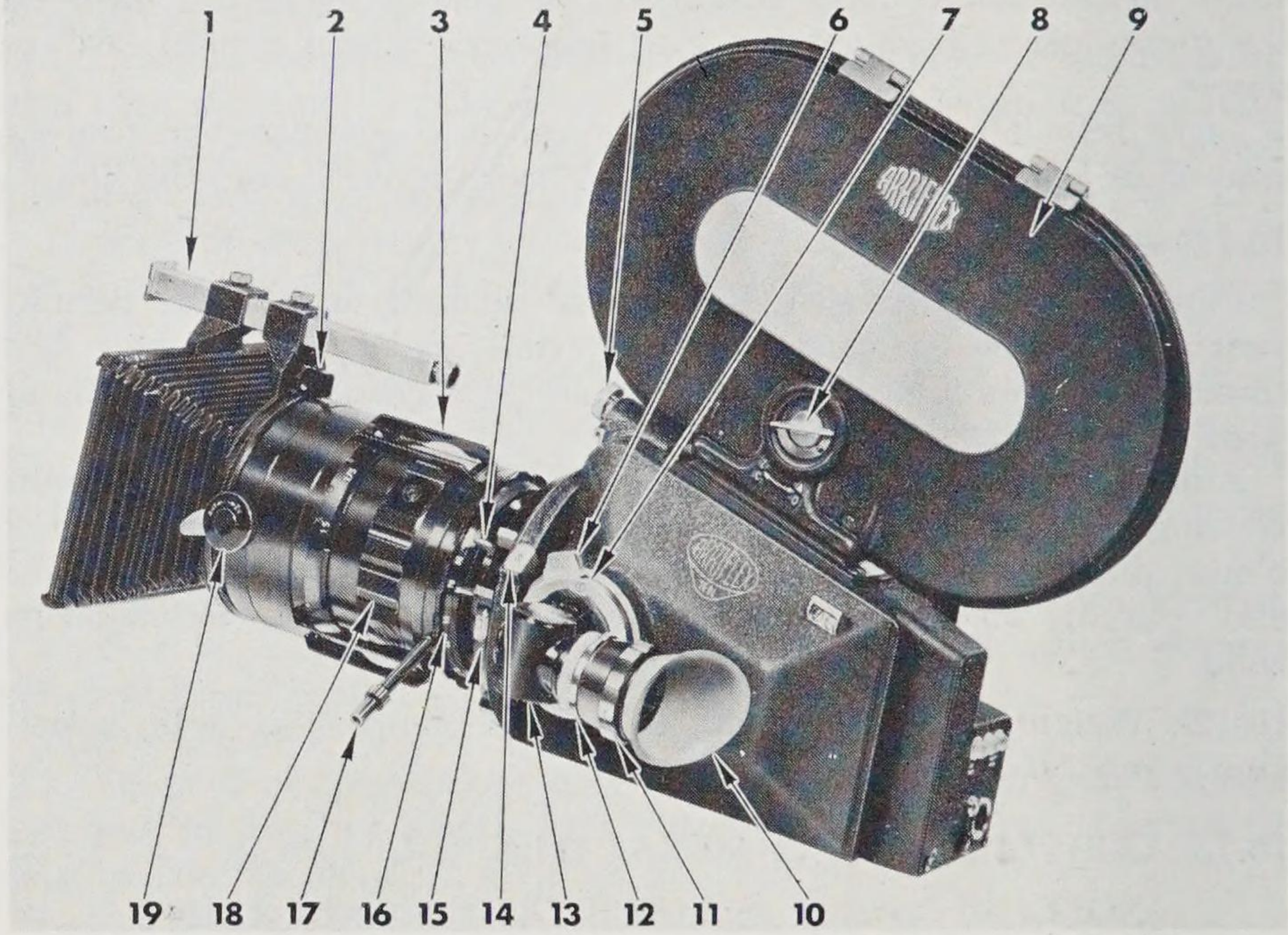


Fig. 10-26. Arriflex 16BL (left side). Courtesy of Arnold & Richter K. G.

1. Sunshade boom
2. Sunshade snap catch
3. Focus grips
4. T stop grip
5. Magazine lockdown knob
6. Door lock
7. Viewfinder lock nut
8. Magazine lock
9. 400-ft magazine
10. Eyecup
11. Focusing ring
12. Focus locking ring
13. Rotating viewfinder
14. Lens release
15. Lens lock
16. Zoom ring
17. Zoom stick
18. Center scalloped ring
19. Filter holder access knob

FWD, to the right for REV. Position of switch can be checked through the window in the plastic cap.

NOTE: A minimum of 12 volts is required to run the camera with a 400-ft load.

A 110V AC line requires a step-down transformer/rectifier.

The following motors are available for the Arriflex 16BL:

Variable speed motor: 12V DC.

Governor-controlled (constant-speed) motor: 12V DC (24 fps); 12V DC (25 fps).

Synchronous motor: 110V AC 60 Hz (24 fps); 110V AC 50 Hz (24 or 25 fps via gear change).

Tuning-fork–controlled motor (for cordless double system sound recording): 12V DC 24 fps (60 Hz signal to tape recorder); 12V DC 25 fps (50 Hz signal to tape recorder).

10.13c Power line

Input to camera: Tuchel female end of cable fits to recessed Tuchel

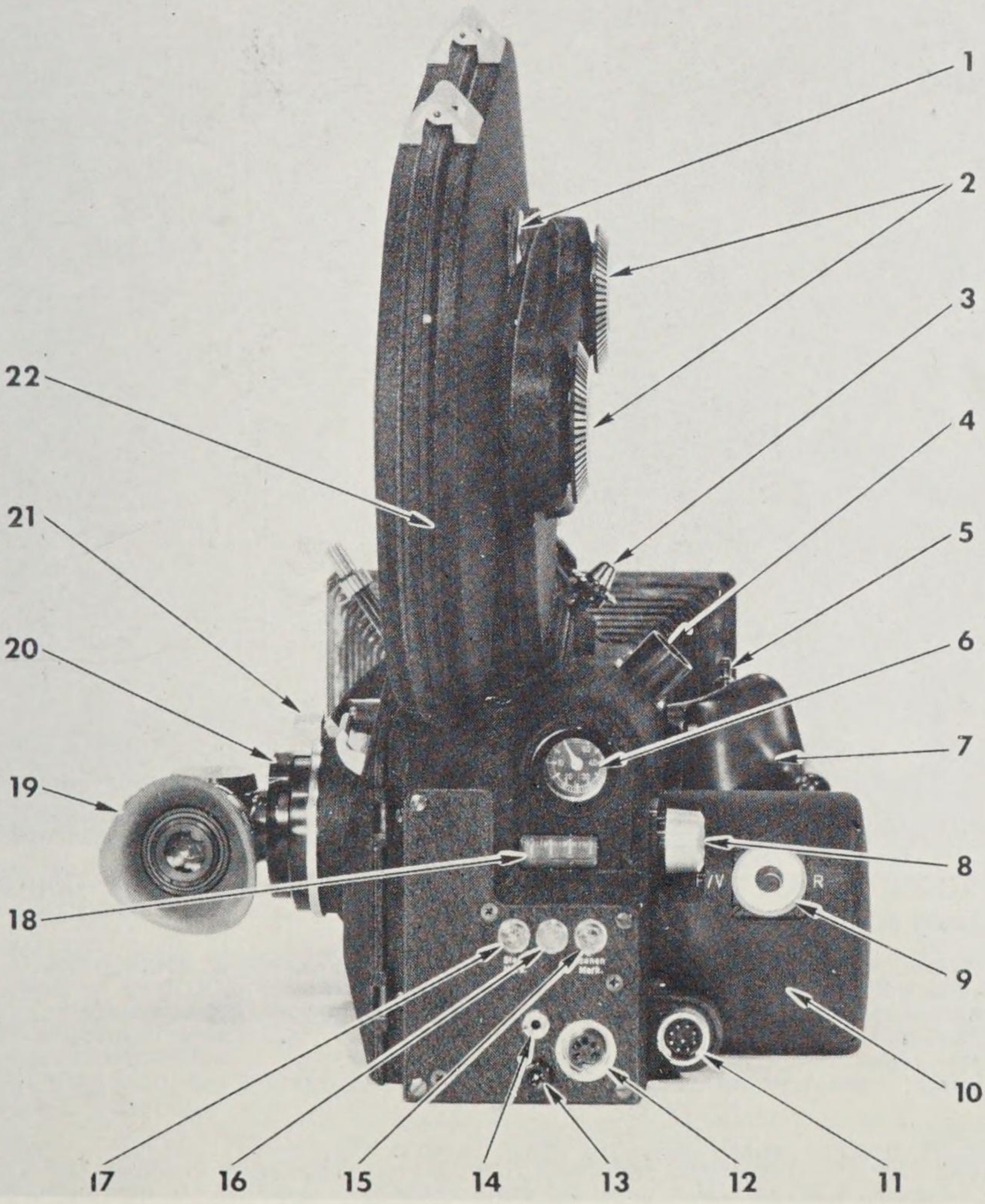


Fig. 10-27. Arriflex 16BL (rear). Courtesy of Arnold & Richter K. G.

1. Magazine footage counter
2. Spindle wheels
3. Inching knob
4. Sound connection to amplifier
5. ON/OFF button
6. Tachometer
7. Contour grip
8. Counter reset knob
9. FWD/REV access cap
10. Motor housing cover
11. Power plug
12. Sync-pulse plug
13. Manual perforation scene marker
14. Phone jack
15. Edge-marker signal
16. Camera running signal
17. Full-frame exposure bloop bulb
18. Footage counter
19. Eyecup
20. Viewfinder lock nut
21. Door lock
22. 400-ft magazine

male plug located below counter reset knob. Insert male end of cable into battery.

ON/OFF button(s) (earlier models, not shown, have two): Located in the hand grip at the right of the camera. On *two-button models*,

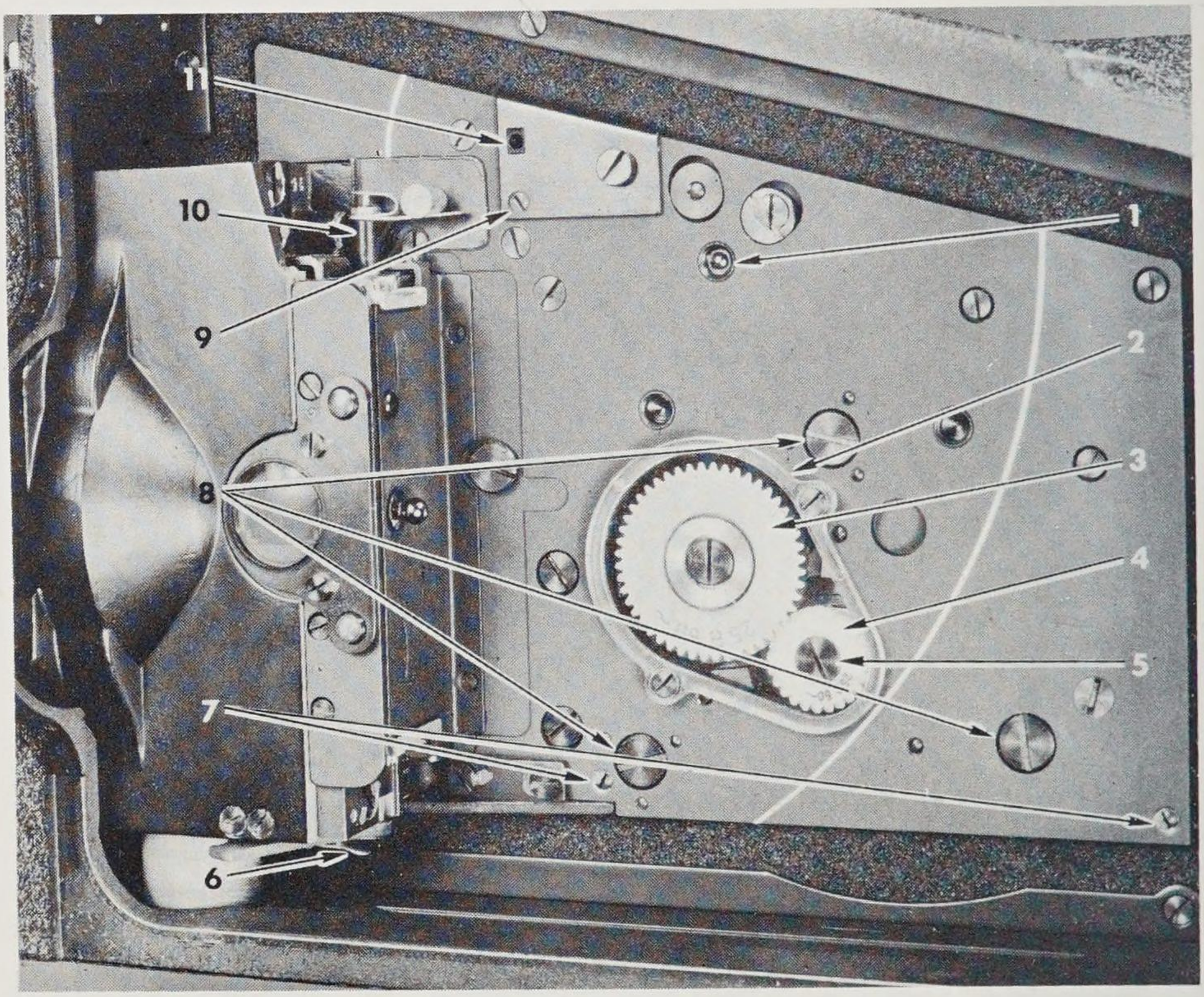


Fig. 10-28. Arriflex 16BL lubrication (sound module removed). Courtesy of Arnold & Richter K. G.

1. Intermediate counter gear lube hole
2. Plastic gear cover
3. Transfer gear
4. Motor gear
5. Motor pinion
6. Interior edge-marking bulb holder
7. Module-mounting screw holes
8. Motor mounting screws
9. Module-mounting screw hole
10. Interior full-frame exposure bulb holder
11. Sound module electrical connector

depress the front button for continuous run, the rear button for OFF or for short bursts. To start camera silently (to eliminate the front button click) depress the rear button first, then depress the front button and release the rear button.

Two-pin plug (not visible): At bottom of the contour grip; for an accessory remote ON/OFF switch which clamps to the tripod handle.

Pistol-grip accessory: Insert into one of the two ⅜"-16 tapped holes in the base. When using a pistol grip fitted with a plunger, the trigger on the grip acts as an ON/OFF switch, bypassing the switch on the hand grip.

Outlets (at back of camera):

1. Main power plug (nine-pin Tuchel) is located below the counter reset knob. 2. Synchronous-pulse (five-pin Tuchel) plug is located below the lamps.

NOTE: As Operator faces the plug, with the keyway at "6 o'clock," pins no. 1 (at 7 o'clock) and no. 2 (at 10 o'clock) are the AC pulse

for the sound recorder; pin no. 3 (at 12 o'clock) is the scene-marking oscillator (pulse for "beep" on recorder); pins no. 4 (at 2 o'clock) and no. 5 (at 5 o'clock), are connected in the cable and provide power for the full-frame and edge-marking bulbs. The lights will *not* work until the cable is plugged into the camera.

3. Upper female jack: accommodates single-system monitoring phones.
4. Lower center-pin jack: accommodates manual-perforation scene marker.

Bulbs (left to right):

No. 1: The interior *full-frame exposure* (see Fig. 10-28) bulb is in series with an exterior (left-side) bulb (see Fig. 10-27); the exterior bulb lights up when the interior signal registers on the film frame.

No. 2: The center *blinking-signal bulb* (see Fig. 10-28) indicates the camera is running.

No. 3: The interior *edge-marking bulb* (see Fig. 10-28) is in series with an exterior (right-side) bulb (see Fig. 10-27). The exterior bulb lights up when the interior signal registers on the film edge.

To replace bulbs: Remove covers at back of camera.

1. *Full-frame exposure:* Unscrew exterior bulb and replace. Open camera door, depress leaf spring above the gate and swing it forward. Gently lift the interior bulb up and out. Replace. Depress and turn leaf spring to lock. 2. *Blinking signal:* Unscrew bulb and replace. 3. *Edge-marker:* Unscrew exterior bulb and replace. Open camera door and depress leaf spring below the gate. Tilt the unit forward and draw the socket downward. Replace the interior bulb. Push leaf spring up and back to secure.

NOTE: With regard to the full-frame and edge-marking bulbs: *always* replace *both* bulbs in series. Since the life expectancy of each bulb is approximately the same duration, two fresh bulbs will eliminate alternate burnouts.

10.13d Turret

None. Single "floating" mount and locking rings accept blimped varifocal lens or standard lenses. (see Sec. 10.13e for exceptions.)

10.13e Lenses

Standard equipment is a blimped Angenieux or Zeiss varifocal lens. Focus marks are inscribed on exterior of lens housing (meters in white; feet in red). The focus reference mark is at the left side. Plastic window at top of the housing permits viewing of corresponding footage and lens focal-length setting. A small window at the top of the mount allows viewing of lens diaphragm setting (in T stops on an Angenieux 12–120mm lens; in *f*-stops on a Zeiss 12.5–75mm lens.

An inscribed "T" mark at the left side of the mount is used for the diaphragm setting reference.

To mount lens: Grasp the lens housing by the center scalloped ring only. With the plastic window *up*, align the bayonet prongs with the grooves in the camera mount. Slide the lens in until the three tabs on the lens housing are seated into the locking-ring notches on the

camera. Rotate the lens mount counterclockwise until it clicks. Rotate the large lens lock counterclockwise (toward "FIX") to secure. Hand-tighten only.

Insert zoom handle into single tapped hole, then back off one-half turn to allow positioning of the handle at desired location on the mount. Tighten the handle and lock it by rotating the lower (larger) knurled knob of the handle clockwise.

To zoom: Use either the handle or the scalloped zoom ring to change focal length.

To focus: Rotate one of the three double-bracketed focus grips on the lens barrel.

To remove lens: Rotate the large lens lock clockwise in the direction of the arrow (toward "LOOSE"). Depress lens release (near the door lock). Rotate lens mount clockwise and slide the lens from the bayonet mount.

To mount standard lenses:

1. Depress the lens release to retract the lens lock at the bottom of the socket. 2. Align the lens-guide slot with the dot in the mount (the dot indicates the position of the guide key) and insert the lens. 3. Let up on the lens release. Tug the lens *gently* to ascertain that the lock has engaged the lens.

NOTE: 28mm or shorter lenses cannot be used on the BL mount because their rear elements will touch the rotating mirror. *Exceptions:* 10mm Cinegon (Schneider), serial nos. 9861975 and higher; 8mm Distagon (Zeiss); 5.7mm Kinoptic Tegea (Cooke).

10.13f Viewfinder: Reflex. Image magnified 10×.

To view through lens: Press eye against eyecup to open automatic eyepiece closure device.

To lock autoclosure device open: Pull eyecup from finder. Rotate inner knurled lock nut clockwise. Replace eyecup.

To align reflex mirror for viewing: Depress and rotate inching knob (shaped like a witch's hat) above the contour handgrip.

CAUTION: Do not depress inching knob while camera is running.

To focus eyepiece: Rotate narrow scalloped ring on eyepiece clockwise to the word "LOOSE." Rotate large scalloped ring nearest eyecup to focus on grain of groundglass. When focus is set, turn narrow ring counterclockwise to "FIX."

Groundglass: On side of movement block. For access, open camera door. Views more than full aperture. Outer scribe denotes full aperture —inner scribe denotes TV aperture.

To change: Loosen two small screws, lift holder out. Always replace with smooth surface toward the eyepiece.

To alter finder position for viewing: Rotate viewfinder lock nut counterclockwise toward "A." Rotate eyepiece in desired direction (it rotates 360°) perpendicular to the camera. Set eyepiece at desired position. Rotate viewfinder lock nut clockwise to "Z" to secure. The unit also swings out 25° horizontally from the camera door.

To remove viewfinder from camera: Rotate viewfinder lock nut counterclockwise toward "A." Rotate viewfinder to vertical position, eyecup up. Pull viewfinder away from camera's internal bayonet lock (not shown).

To detach eyepiece: Rotate knurled ring forward of eyepiece lock on viewfinder clockwise and pull eyepiece from the keyed slots.

10.13g Sunshade

Sunshade/bellows slides in and out on square boom which attaches to the zoom lens.

To remove from the zoom lens: Lift the sunshade snap catch (at the top of the rear sunshade plate). Pull the sunshade down and forward.

To mount on zoom lens: Rest the projecting piece (at the rear of sunshade) between the two lugs at the front of the lens. Push the top of the shade toward the lens until the sunshade snap catch engages the rear sunshade plate.

To use with conventional lens: Requires an Arriflex Universal Lens-Housing Unit (not shown). The sunshade mounts onto the Lens Housing the same as onto the zoom lens.

Sunshade boom: Scribed with various extension limitations. Set the forward knurled boom lock between the two scribed arrows for the desired focal length.

> NOTE: The camera shoe located below the magazine lock knob is intended for use with a quick-detach carrying handle, and *not* with the sunshade boom, as on other Arriflex cameras.

10.13h Filters

To remove filter holder from lens: Rotate knurled knob at left side of lens housing marked "Auf–Zu" (open–closed). Swing sunshade away. Grasp circular filter holder by its knurled ring and pull it out.

To insert filter into holder: Rotate the filter notch toward the nearest corner until both square cut outs match. Insert a 3 × 3 in. filter, and rotate the filter lock to secure.

> NOTE: Rotation direction is determined by the thickness of the filter. Less than 5mm (Arriflex manufacture)—rotate the lock counterclockwise. More than 5mm (Wratten manufacture)—rotate the lock clockwise.
>
> WARNING: When no filter is used, an optical flat must always be inserted into the filter holder to block camera noise that may travel through the lens and into the shooting area.

To insert holder into lens: Grasp holder by knurled edges. Align pin on the holder with any one of the four holes in the mount. Insert into lens. Close and lock sunshade.

10.13i Single-system sound module

To insert sound module into camera (see Fig. 10-28): Remove the internal transparent plastic gear cover which is secured by two screws. Remove the three green colored screws, which protect the threaded screw holes for mounting the module. These screws are located:

1. In the upper left-hand section near the connector plug. 2. In the lower left-hand section. 3. In the lower right-hand section. The single-system module is inserted by aligning and plugging it into the miniature electrical connector, then securing the module with the three green colored screws.

10.13j Door: Hinged at back.

To open: Rotate door lock counterclockwise (toward "A"). Swing eyepiece in a horizontal plane away from camera.

To close: Swing eyepiece toward camera. Rotate door lock clockwise (toward "Z") to secure.

10.13k Magazines: 400-ft and 200-ft.

To mount:

1. Rotate knurled lock knob (above the lens) clockwise until spring action frees the lock. 2. Remove the dust cover from the camera housing, and insert the film loop into the camera cavity. 3. Seat rear male dovetail of magazine into rear female dovetail on camera housing. Lower the front male dovetail into the camera housing. Rotate inching knob to engage gears. Thread camera (Sec. 10.13l). 4. Depress magazine lock knob and rotate it counterclockwise to lock.

To remove: Remove film from gate. Rotate magazine lock clockwise until lock is free. Lift magazine away.

10.13l Threading (Fig. 10-29)

1. Push pressure-pad catch toward interior wall, and swing hinged pressure pad open. 2. Rotate inching knob until single registration pin enters the gate and the single pulldown claw is withdrawn from the gate. 3a. Insert film into gate. Conform upper and lower loops to scribed lines in interior. Rotate inching knob until registration pin enters gate and engages perforation. Close pressure pad.

> CAUTION: The pressure-pad lock must be engaged and the film must lie *inside* the side guide springs. Double check after each loading.

3b. *Single system:* After threading the film through the gate, thread film according to the white guide line scribed on the sound module. Open the pressure roller by pressing, to the right, the thumb lever protruding from the idler roller on the lower pivot arm. 4. Insert film between the pressure roller and the large upper roller. 5. Insert film between the recording heads and the guide rail. 6. Guide film around the sound drum, and over the lower roller. 7. Guide film under the tension roller, and to the right of the "mag" roller, into the magazine.

> NOTE: When the camera is started, the tension roller will adjust upward automatically, pulling the tension arm upward and releasing the flywheel brake.

8. Depress ON/OFF switch in contour grip. Observe action of film. If satisfactory, close door and reset footage counter.

10.13m Buckle-trip: None.

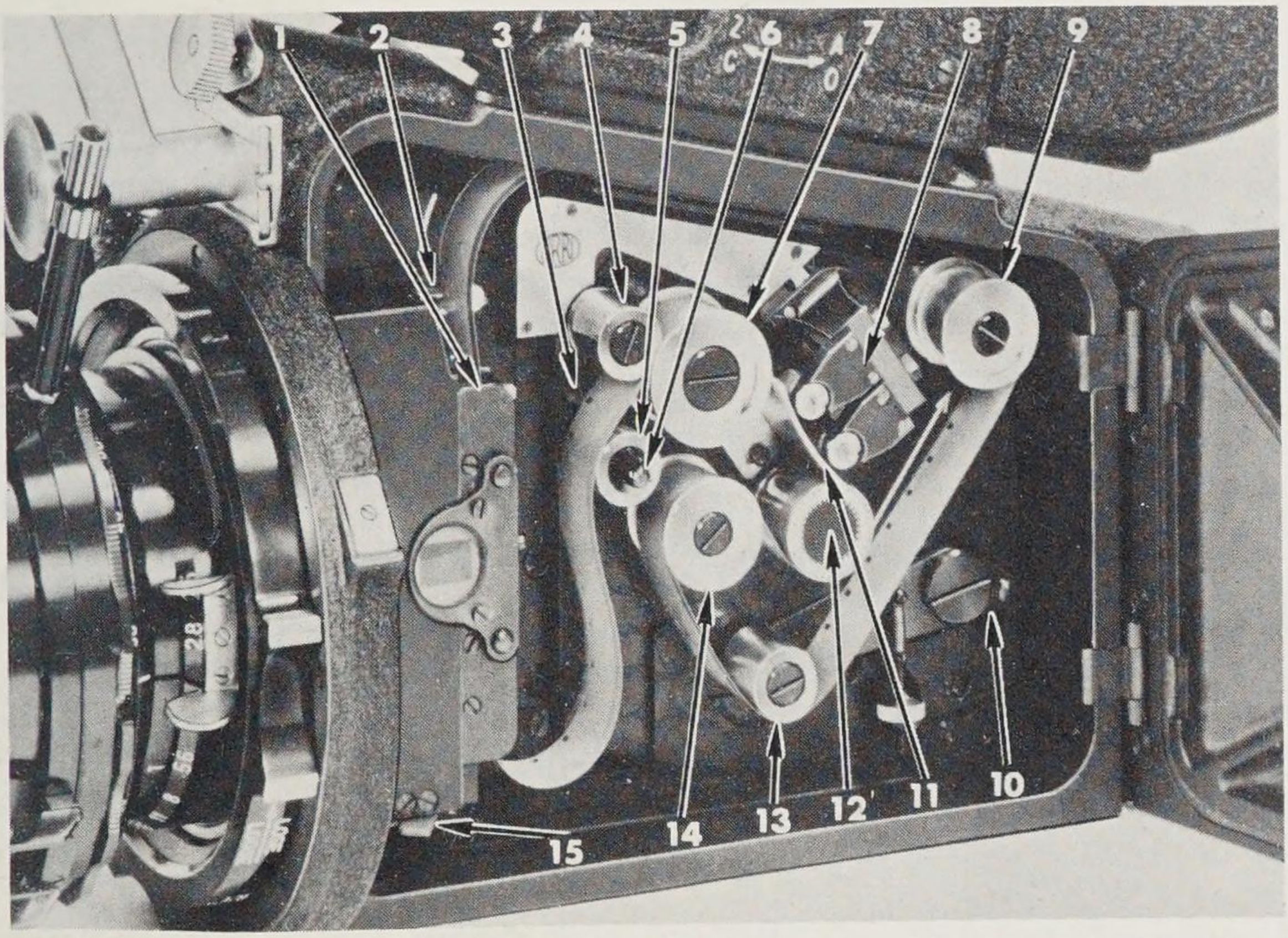


Fig. 10-29. Arriflex 16BL threading detail. Courtesy of Arnold & Richter K. G.

1. Pressure plate
2. Full-frame exposure bulb leaf spring
3. Lower pivot arm
4. Pressure roller
5. Idler roller
6. Thumb lever
7. Upper roller
8. Recording heads
9. Magazine roller
10. Flywheel brake
11. Guide rail
12. Sound drum
13. Tension roller
14. Lower roller
15. Edge-marking bulb leaf spring

10.13n Footage counter

Located at back of camera below tachometer. Additive. Counter registers 0–999 ft in increments of one foot, then reverts to zero. Additional *red digit* in the counter registers 0–1 ft in increments of 1/10 foot.

To reset: Depress large knurled knob at right of counter and rotate counterclockwise.

NOTE: There is *no* frame counter.

10.13o Tachometer

At back of camera. Registers speeds from 0–50 fps in increments of one frame per second.

CAUTION: Camera is not governor controlled. A variable-speed motor *can and will* run faster than 50 fps. It cannot be assumed that by arbitrarily turning the rheostat so that the needle registers 50, the camera is running at 50 fps. Incorrect exposure can result if the camera speed is not deliberately and conscientiously set by the Cameraman.

10.13p Shutter: Nonadjustable. Equivalent to 180°.

10.13q Lubrication (Fig. 10-28)

Manufacturer recommends two to three drops of oil every 10,000 ft on the following: Depress ball bearing oil valve behind the film gate to lubricate the intermediate counter gear.

CAUTION: Manufacturer warns that oiling too frequently and/or excessive oil can damage the camera mechanism.

10.13r Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Open pressure pad and check plate and pad for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on interior of camera to remove dust, dirt, etc.

10.13s Weight: (with 400-ft load): 20 lb.

10.13t Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Battery connections loose; battery dead; motor not making contact
Intermittent starting and stopping	Lugs in battery loose; broken connection in power line; motor governor has carbon build-up
Torn perforations; ripped film	Improper threading
Door will not close	Dirt or film chip(s) in door; film not seated in gate
Viewing system blacked out	Shutter closed; eyepiece cap closed; lens stopped down past *f*/22; lens cap on
Lens will not focus	Lens not seated; camera too close for minimum distance of lens; elements damaged
Cut-in on groundglass (wide-angle lens)	Viewing mirror "sees" aperture of lens, but camera aperture does not—no problem if lens is seated properly
Cut-in on groundglass (normal lens)	Lens not seated; matte box extended
Lens will not enter port	Guide key inside turret bent so that it will not enter the lens channel; lens not suited for BL (shorter than 28mm)—see "Note" at end of Sec. 10.13e
Film does not take up in magazine	Magazine take-up spindle loose; film loose on take-up core; incorrect magazine friction

10.14 ARRIFLEX 16BL MAGAZINE (Fig. 10-30)

10.14a Type: Displacement.

10.14b Capacity: 400-ft (shown) and 200-ft.

10.14c Lid: One. Lug- and dog-locked. Hinged at top.

To open: Depress safety spring in lid recess. Rotate lock bar counterclockwise (from "C" to "O"). Lift.

10.14d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

10.14e Take-up

Right side. Film winds on spindle clockwise, emulsion always in.

10.14f Loading

1. Raise lid. Swing the footage-counter/roller-guide arm to the right and lock it into the pressure catch of the take-up roller-guide arm. 2. In darkness, remove film roll from can and bag. Insert film end into left side of magazine throat, slowly rotating gear at bottom clockwise with thumb until gear in throat engages film perforation. Thread at least 6 in. through.

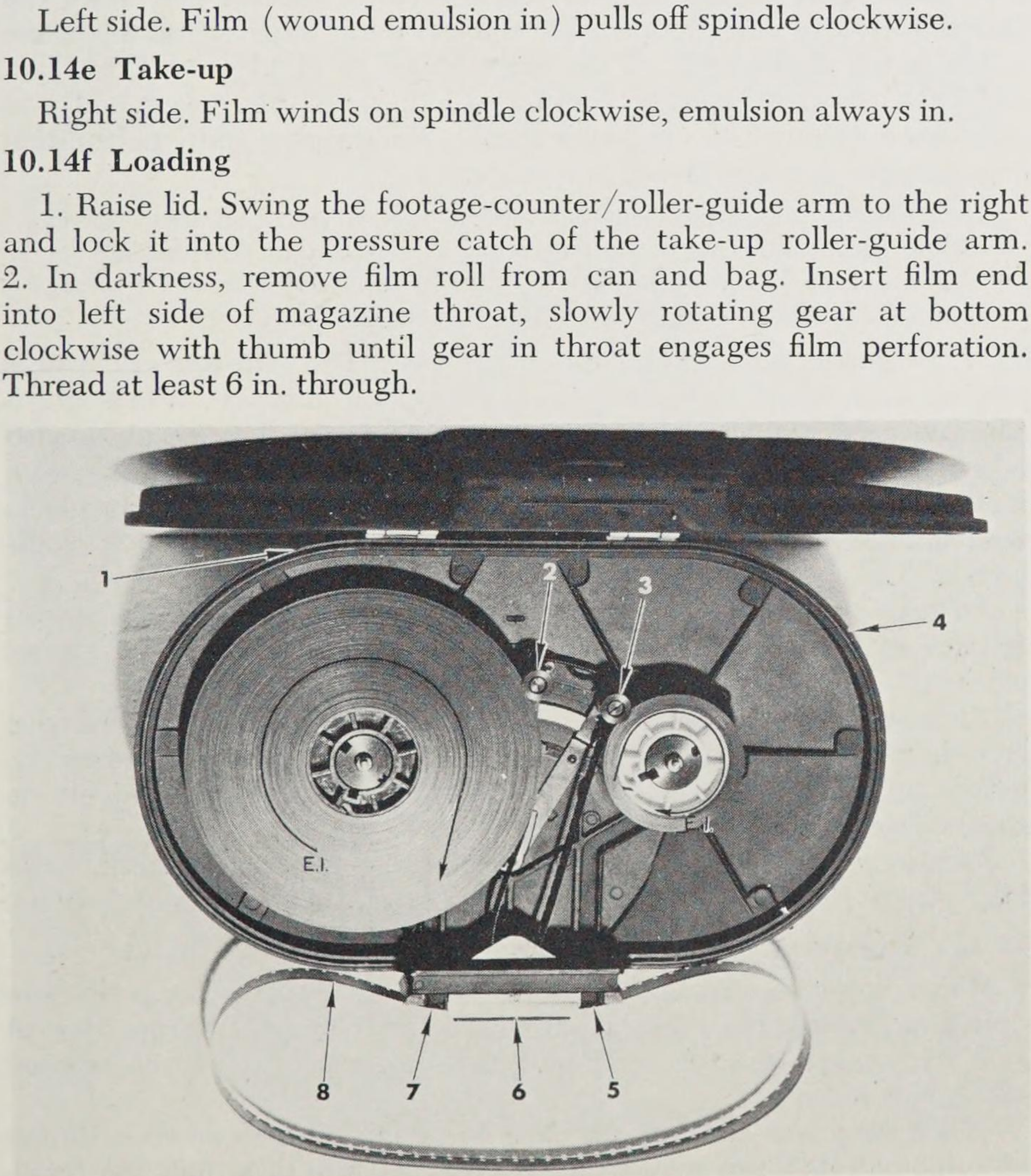


Fig. 10-30. Arriflex 16BL 400-ft magazine. Courtesy of Arnold & Richter K. G.

1. Marking notch for silent loop
2. Footage counter/feed roller guide
3. Take-up roller guide
4. Marking notch for sound loop (72–75 perforations)
5. Take-up light trap
6. Loop retaining plate
7. Feed light trap
8. 72-perforation loop

NOTE: To expedite engagement of film in the magazine gears, cut the film so as to bisect a perforation.

3. Place film roll on the feed spindle. Rotate knurled feed-spindle wheel until spindle key engages the core keyway. 4. Release footage-counter/roller-guide arm, making certain film rides between the flanges of the roller guide. 5a. *For BL's fitted with double (silent) system:* Rotate gear until film end extends clockwise around the left outer edge of the magazine to the notch at the left of the left hinge. 5b. *For BL's fitted with a single-system sound module:* Rotate gear until the film end extends clockwise around the left outer edge of the magazine to the notch at the right of the right hinge. 6. Hold gear. Bring film end back counterclockwise, forming a loop, and then insert end into right-hand channel of magazine throat. Rotate gear until perforation engages gear and film moves into magazine.

CAUTION: It is important to maintain the proper loop size: 40–41 *visible* perforations for double system; 72–75 *visible* perforations for single system. Do not allow excess film to exit feed side while trying to engage perforation onto take-up gear.

7a. *If magazine has a collapsible core:* Insert film end into collapsible take-up core. Move the clamp inward to secure film. 7b. *When magazine has a plastic core:* Place core on take-up spindle. Rotate knurled take-up spindle wheel until spindle key engages the core keyway. Insert film end into core slot and wind film onto take-up core clockwise (emulsion in). 8. Close hinged lid. Rotate recessed lock clockwise to "C."

To take up film slack: Depress and rotate knurled spindle wheels at back of magazine. Take-up rotates counterclockwise. Feed rotates clockwise.

To load daylight spools: Depress center of core spindles and remove core holders and/or collapsible core. Squeeze film-tension arms together and snap into catch in center of magazine. Place spools on square driver pins of spindles.

Film-loop guard: Depress film loop against magazine mouth. Slide loop guard (with notch inward) over film and under retaining plate.

10.14g Unloading: In darkness, remove magazine take-up lid.

When magazine has a collapsible core: Disengage clamp on core (push outward). Place index finger in core space, thumb on edge of roll. Turn magazine over and let film drop into the hand. Place exposed roll in bag and can.

When magazine has a plastic core: Place index finger on core, thumb on edge of roll. Turn magazine over and let film drop into the hand. Place exposed roll in bag and can.

10.14h Footage counter

At back of magazine. Subtractive; 500–0 ft in increments of 50 ft.

CHAPTER 11

Auricon Cameras and Magazines

11.1 16mm AURICON PRO-600 CAMERA (Figs. 11-1, 11-2)

NOTE: All directions are from the Operator's point of view.

NOTE: Two models of the Pro-600 are manufactured: the Pro-600 Studio Camera, and the Pro-600 Special. The Special (intended for newsreel work) is of the same engineering as the Studio Camera but with these modifications: a single-lens turret; a smaller motor housing; a zoom-lens door; no telefinder eyepiece; utilizes a 400-ft magazine; and weighs less. Unless otherwise noted, the text covers the Studio Camera model.

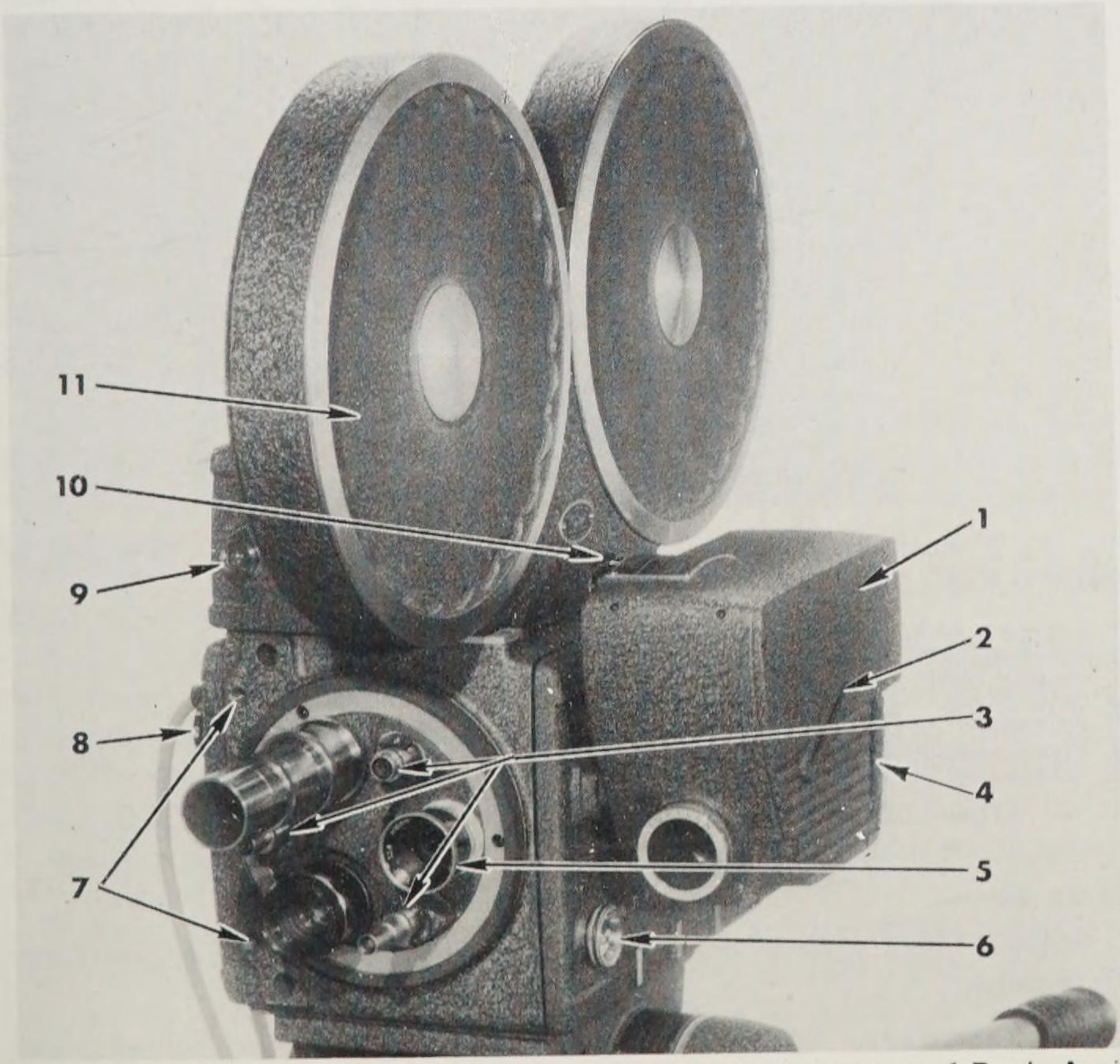


Fig. 11-1. Auricon Pro-600 (lens hood removed). Courtesy of Bach Auricon, Inc.

1. Viewfinder
2. Matte slot
3. Telefinders
4. Matte storage
5. Taking lens
6. Door knob
7. Lens-hood bracket-mounting screw holes
8. Focus eyepiece
9. Camera-on warning light
10. Viewfinder-focus indicator/parallax adjustment
11. 600-ft magazine

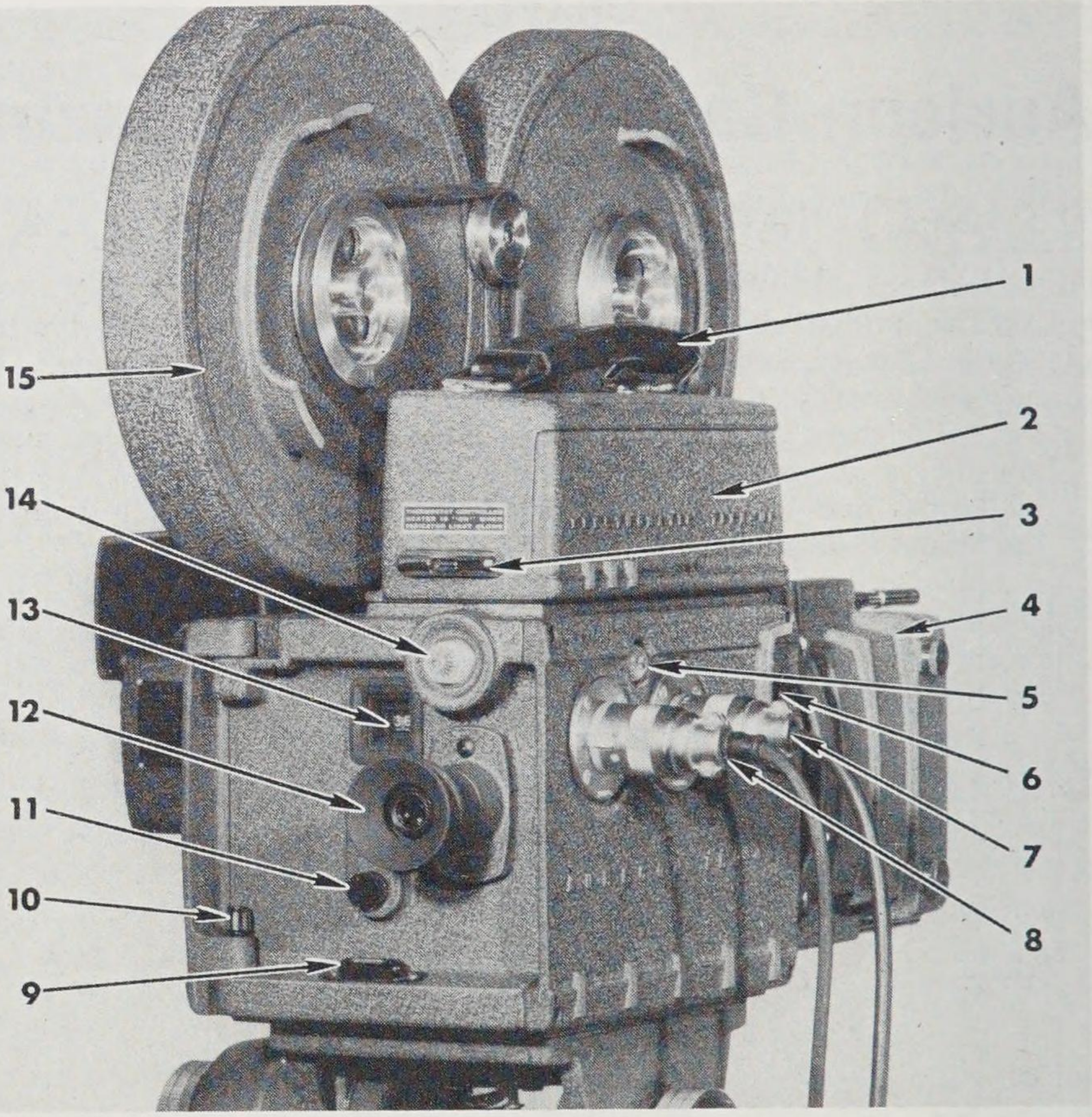


Fig. 11-2. Auricon Pro-600 (rear view, lens hood in place). Courtesy of Bach Auricon, Inc.

1. Carrying handle
2. Take-up motor
3. Heater light
4. Lens hood
5. AC light
6. Focus eyepiece
7. Sound-line input
8. Power-line input
9. Bubble level
10. Door thumb nut
11. ON/OFF button
12. Telefinder eyepiece
13. Footage counter
14. Camera-on warning light
15. 600-ft magazine

11.1a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lock-down screw.

11.1b Rackover: None.

11.1c Focusing tube

Focus eyepiece: Located at right front side. Magnifies 7×. Rotate to achieve focus on groundglass.

NOTE: The eyepiece at the back of the camera is a telefinder eyepiece only (see "telefinders" in Sec. 11.1f) and *cannot* be used to focus the lens.

To focus through lens: Rotate turret (see Sec. 11.1f) until red dot above the taking lens aligns with the red dot at top of turret marked "FOCUS."

WARNING: Camera will *not* run in "FOCUS" position.

Groundglass: Nonremovable.

To clean groundglass: Rotate turret to "FOCUS" position. Remove taking lens. Insert cotton swab dampened with filtered cleaner provided by manufacturer and clean groundglass face.

11.1d Motors

Camera: 115V AC synchronous; built-in; nonchangeable; nonreversible.

Take-up: Built-in; nonchangeable; nonreversible. When AC line is hooked up to the camera, the take-up motor applies one-third power to the take-up belt only. The belt in turn provides tension on the threaded film, which, looped around the Safety-Switch Arm roller (see Fig. 11-3), pulls the arm forward and permits the camera to run (see Sec. 11.1n, Buckle-trip).

NOTE: Full power is applied to the take-up belt only when the ON button is pressed.

There are *no* variable-speed, high-speed, or animation motors for the Pro-600.

11.1e Power line

Input to camera: The three-pin Cannon plug AC connector is at the right side of the camera. The eight-pin Cannon plug is for sound.

Amber light (between the plugs): Glows to indicate there is AC to the camera.

ON/OFF buttons: Located at the back of the camera; color-coded: Black = on; red = off.

Neon heater light: Located at back of take-up–motor housing. Glows to indicate the internal thermostat control is on. The heater turns on automatically whenever the camera temperature is below 65°F and may remain on until a camera temperature of about 80°F is reached. The light extinguishes when the camera rolls. The neon heater lamp is nonchangeable; replacement of the entire lamp unit is required when burned out.

"Camera-on" warning light (at the front of take-up–motor housing–Fig. 11-1): In series with a camera-on warning light at the back of the camera (above the telefinder eyepiece–Fig. 11-2). Both lamps illuminate when the camera runs.

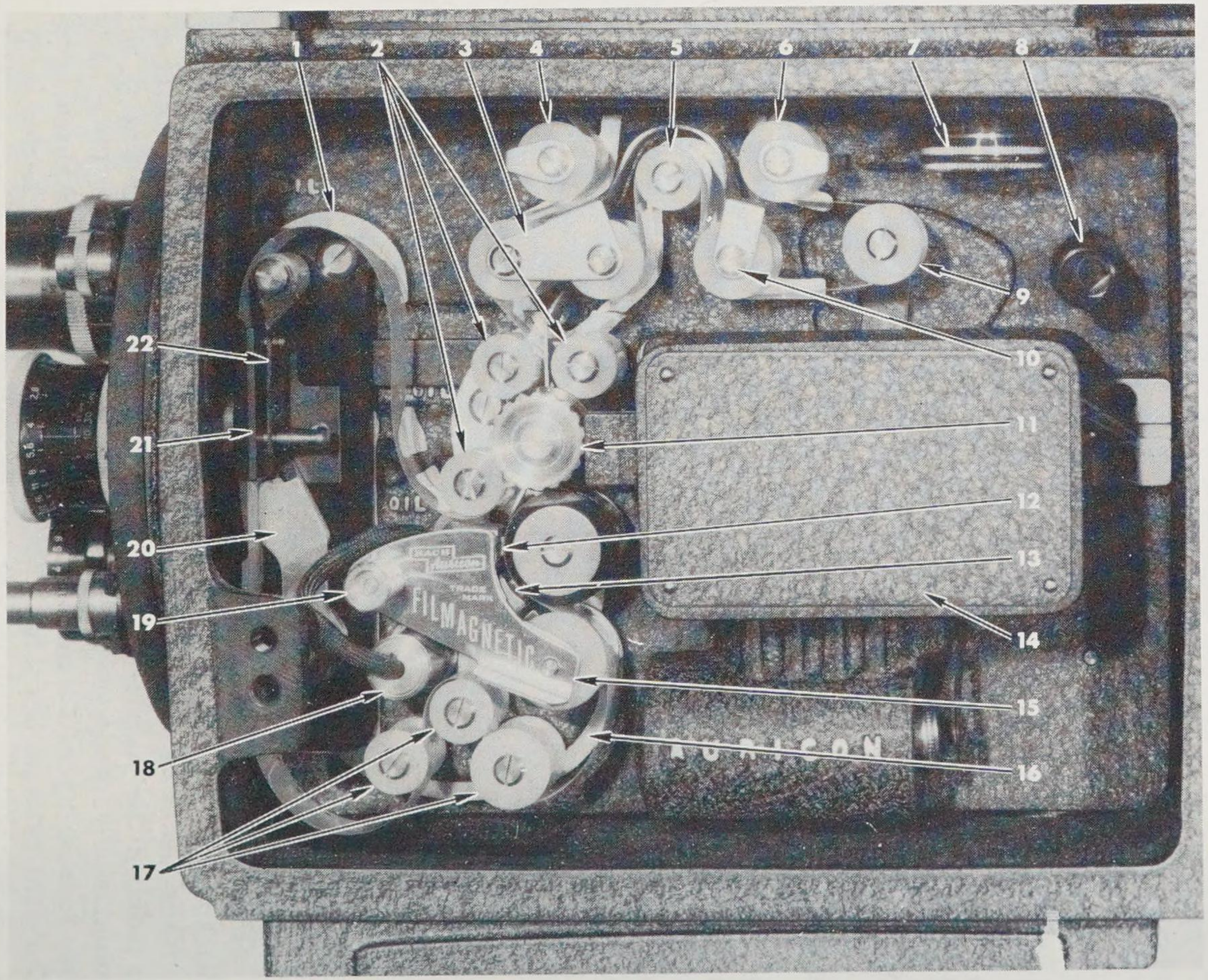
To change bulbs: Amber AC power indicator and camera-on lights: unscrew plastic lamp housings; depress and rotate bulbs counterclockwise and remove.

11.1f Turret: Accommodates C-mount lenses.

NOTE: The Studio Camera has either a single-lens turret with one telefinder, or a three-lens turret with three telefinders. On a *three-*

Fig. 11-3. Auricon Pro-600 threading detail with Filmagnetic unit installed. Courtesy of Bach Auricon, Inc.

1. Upper loop guide
2. Sprocket-guide rollers
3. Double-roller bracket
4. Feed roller
5. Center roller
6. Take-up roller
7. Magazine lockdown screw
8. Footage counter reset knob
9. Buckle-trip (Safety Switch Arm)
10. Single-bracket roller
11. Recording sprocket
12. Reproduce head
13. Record head
14. Galvanometer
15. Retaining arm pushdown tab
16. Lower optical loop guide
17. Triple rollers
18. Magnetic head connector plug
19. Scalloped nut on sound unit support arm
20. Pulldown claw protector
21. Pressure plate
22. Pressure-plate retaining spring



position turret, the lens directly next to the viewfinder is the taking lens. The Special has a single-lens turret and *no* telefinder.

To rotate: Grasp turret by the telefinder projections (at center of turret), turn until desired lens is in taking position.

To lock: To keep the weight of a heavy lens from rotating the turret, remove the upper right lens and insert a lock nut into the tapped hole behind the turret.

Telefinders: Manufactured in sizes from 10mm to 150mm, to match lenses of corresponding focal length. Telefinders are particularly advantageous for use with the telephoto lens (75mm and longer) when the opening in the plastic viewfinder matte becomes too small to view the object being photographed. When viewed through the eyepiece, the image is magnified 10×. The field of the telefinder must be aligned with the field of the taking lens before it can be used.

To mount and align telefinder:

1. Select a telefinder with a focal length corresponding to that of the taking lens. 2. Remove the three hex-head screws and coverplate from the telefinder socket, which is horizontally opposite the lens. 3. Insert the telefinder ball mount into its socket, flush with the flange. Insert and hand-tighten the three coverplate screws into the flange. 4. Remove pressure plate from gate. Insert focusing prism in gate. Align the taking-lens field to an object. 5. Sight through eyepiece and adjust the three screws until the telefinder field frame is in alignment with the taking-lens field. Tighten screws securely.

11.1g Lenses: C-mount.

To fit lens to turret: Align lens threads with turret port, rotate lens until seated. Finger-tighten only.

11.1h Viewfinder

Offset. Permanently installed on camera door of Studio Camera. (The Special uses a zoom lens.)

Two types available: Manufacturer calls them (1) standard, and (2) autoparallax. Neither type has a cross hair in its optics.

Standard viewfinder (not shown): Fixed mount is an integral part of the door. Plastic matte corresponding to lens in use is inserted in front of finder, from the top. Peephole sight is at back of finder. Full field of the viewfinder without a matte corresponds to a 13mm lens field.

Parallax adjustment: Align circular eyepiece scale at rear of finder with scribe mark.

Viewfinder does not focus.

Autoparallax viewfinder (shown): Adjustable mount, i.e., as the focus indicator at the top of the viewfinder is moved to a specific distance on the scale, the field of the viewfinder shifts automatically into correct parallax.

A full complement of plastic mattes may be carried in a holder at the side-rear of the finder. The matte corresponding to the lens in use is inserted into the angled holder at the front side of the viewfinder.

The matte inserts with the focal-length numeral on its tab upright and visible to the Operator. A properly inserted matte will have only its tab showing. Notches in the matte prevent upside-down or backward insertion.

Full field of the viewfinder without a matte corresponds to a 17mm-lens field on 16mm cameras. (When viewfinder is used on a 35mm camera, the full field corresponds to a 35mm lens.)

Focus: Indicator at top of viewfinder moves from 4 ft to infinity.

Parallax adjustment: Set focus indicator at top of viewfinder to correspond to the focus setting on the taking lens.

> CAUTION: The viewfinder and lens are *not* coupled. After focusing the lens, the viewfinder must be focused manually.

Frame-line adjustments: If the *viewfinder top and bottom* frame lines do not match the camera-aperture top and bottom frame lines:

1. Insert a focusing prism into the camera gate. Set the taking lens at infinity. Align the aperture top and/or bottom frame line with a horizontal object. Close the camera door. 2. Set the footage indicator at infinity. Remove six screws and the side plate from viewfinder. Slide the rear window out of its notch. 3. With an Auricon wrench, loosen the socket set screw located at the right side, forward of the window notch. Rotate the knurled adjusting knob below the window notch until the image in the viewfinder matches the image in the aperture. Tighten the socket set screw, replace the window and the side of the viewfinder.

If the *viewfinder side lines* do not match the camera aperture side lines after the footage indicator at top of the viewfinder has been set to match the footage set on the lens:

1. Insert a focusing prism into the aperture gate. Set the lens at the subject focus. Align the aperture field with the subject. Close the camera door. 2. Set the viewfinder footage scale to coincide with the focus set on the lens. 3. Remove the cover plate from the bottom of the viewfinder and loosen the two cam-locking screws at the front of the cam plate. 4. Slide the cam plate forward or back until the image in the viewfinder is in parallax-corrected position for the distance set on the viewfinder footage indicator (which should coincide with the focus set on the lens). Rotate the cam-locking screws until snug. 5. Compare the viewfinder field alignment with the image in the focusing prism. If satisfactory, tighten the cam-locking screws.

11.1i Lens hood/sunshade

Lens hood: Unit "blimps" the turret to eliminate camera noise that might be transmitted through the lenses. Unit mounts on two rods that fit into a bracket.

The arc-shaped bracket is independent of the camera. Unlike most brackets, which fit to the bottom-front base of a camera, the Pro-600 bracket mounts vertically into two tapped holes at the right side of the turret. The hood slides in and out only.

To clear lens hood from turret: Depress the spring-release catch in the top rod channel. Slide hood forward. Let go of the spring-release catch so it can drop into forward depression in rod.

To remove hood: Depress the spring-release catch in the forward depression on the left rod. Pull hood off.

Sunshade: Collapsible. Unit mounts to lens hood by inserting notches at rear of sunshade under the four knurled screws on the hood. Sunshade is open at the left side to provide unobstructed viewing area for the viewfinder.

11.1j Filters: Fitted to individual lenses. No holders or internal slot.

11.1k Door: Three types available: (1) Standard; (2) Autoparallax; (3) Zoom.

Standard door (not shown): Fitted with a fixed viewfinder that is an integral part of the door.

Autoparallax door (shown): Fitted with tapped holes and screws that will secure the adjustable viewfinder to it.

Zoom door (not shown): A plain door with *no* tapped holes or fittings for mounting a viewfinder.

To open: Rotate knurled knob (at front of door) counterclockwise.

To change door: Remove scalloped thumb nut on bottom-rear hinge. Lift door straight up and off.

11.1l Magazines: 600-ft (Studio); 400-ft (Special).

To mount:

1. Pull a loop from the magazine feed side. 2. Insert magazine toe into magazine guide groove (top of camera). Draw film loop into camera body. 3. Lower magazine until tapped hole in magazine heel aligns with the single magazine lockdown screw inside camera above the Safety Switch Arm roller (buckle-trip). Rotate the screw knob clockwise to secure magazine. Thread camera (see Sec. 11.1m)

CAUTION: Never place the take-up belt on a magazine that has not been threaded. The one-third power on the take-up motor (see Sec. 11.1d) will pull the film into the take-up side of the magazine.

11.1m Threading (Fig. 11-3)

NOTE: The lower loop of a threaded camera varies, depending on whether optical or magnetic sound system is used. Camera is fitted with interchangeable heads. This interchangeability constitutes what manufacturer calls "Filmagnetic" system. Older cameras, unless customized, do not have the Filmagnetic feature. All cameras which have been prepared for Filmagnetic have a removable set of lower-loop rollers. The retaining arm that holds these rollers in place bears the name "Filmagnetic."

To replace optical with magnetic head:

1. Unscrew scalloped nut on sound-unit support arm. Remove the flat retaining arm (stamped "Filmagnetic"). Pull optical roller-arm unit straight out. 2. Insert four-pin male plug of magnetic connector into camera body plug, making certain to align yellow dots on plug and

camera. 3. Slide magnetic head onto support arm as far as it will go. 4. Place rectangular hole of "Filmagnetic" retaining arm onto matching key of spindle. Depress retaining arm to engage roller-arm pin on right hole of retaining arm. Unit will snap up. 5. Engage scalloped nut on support arm.

To replace magnetic head with optical head: Reverse the procedure outlined above.

To thread camera:

1. Lift pressure-plate retaining spring. Remove pressure plate and place on bottom of camera interior below gate.

> NOTE: Manufacturer states it is not necessary to remove the pressure plate when threading. This is true. However, experience in the field substantiates the belief that removal of the unit allows more thorough checking of plate and aperture cleanliness and quicker pulldown-claw engagement of the film.

2. Slide pulldown-claw protector toward rear of camera to expose single pulldown claw. Rotate scalloped eight-tooth recording sprocket until claw retracts from gate. Release claw protector. 3. Pull film from magazine feed side. Extend loop to right front of camera (a rough guide for amount of film needed for threading). Insert film: (a) To right of feed roller; (b) to left of double-roller bracket; (c) *between* the upper left sprocket-guide roller and the eight-tooth recording sprocket; (d) under the lower left sprocket-guide roller. 4. Loop film to conform to curvature of upper raised-metal loop guide. Pull pressure-plate retaining spring back and insert film into gate. Drop pressure-plate retaining spring. 5. Pull back claw protector. Rotate recording sprocket until pulldown claw enters gate and engages film perforation. Release pulldown claw protector. Raise pressure-plate retaining spring. Insert pressure plate (small pin up) and lower the retaining spring so that the notch in the spring engages the finger grip of pressure plate. 6a. *Standard Optical Track—Lower loop* (not shown): Conform lower loop to curvature of raised-metal loop guide. Depress pushdown tab on retaining-arm plate to separate optical roller from recording sprocket. Insert film to right of optical roller and *between* the large lower sprocket-guide roller and recording sprocket, then *between* recording sprocket and upper-right sprocket-guide roller. 6b. *Magnetic Track—Lower Loop:* Loop film to right of small triple roller, over center triple roller, then under the large triple roller. Depress pushdown tab on Filmagnetic retaining-arm plate to separate the record head and the reproduce head from recording sprocket. Insert film *between* record and reproduce heads and recording roller, then to the right of the recording sprocket and left of the sprocket-guide roller. Adjust film so that lower loop clears bottom of camera by 1/8 in. 7. Wind film to right of double-roller bracket, over the high center roller, and to the left of the single-roller bracket; then around the right side of the safety-switch arm (buckle-trip), and then to the left of the take-up roller. 8. Remove slack on the take-up core. Engage belt on the magazine take-up and center spindle wheels.

NOTE: Neoprene belt is designed to fit 400-ft, 600-ft, and 1200-ft magazines. Rotate recording sprocket and observe film being transported in camera. If satisfactory, proceed to step 9.

9. Apply power in short bursts and observe action of film. If satisfactory, stop camera, reset footage counter, and close door.

11.1n Buckle-trip

Manufacturer calls it a "Safety Switch Arm." Spring-tension roller, located at left of footage-counter knob and above galvanometer, cuts out power when arm is toward rear of camera or when film fails to take-up.

To run camera without film: Push arm forward, insert wedge between roller and interior of camera.

Buckle-trip warning: Buzzer sounds when safety-switch arm drops toward rear of camera.

11.1o Footage counter

At back of camera. Additive. Registers each foot of film transported through camera, 0–999, then reverts to zero and counts forward again.

Reset knob: Located inside camera above galvanometer.

NOTE: There is *no* frame counter.

11.1p Tachometer: None.

11.1q Shutter: Nonadjustable; 173°.

11.1r Lubrication (Fig. 11-4)

Manufacturer recommends lubrication of the following parts every 10,000 ft with one or two drops of oil:

Three holes marked in red inside camera:

1. Hole above sprocket (eight-tooth sprocket shaft). 2. Hole left of sprocket (shutter and pulldown movement). 3. Hole above gate (shutter and pulldown movement).

11.1s Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove and clean pressure plate. 2. Remove emulsion build-up with orangewood stick. 3. Wipe gate with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on interior of camera to remove dust, dirt, etc.

11.1t Weight: (with 400-ft load) Studio Camera: 38 lb; (with 400-ft load) Special Camera: 25-1/2 lb.

11.1u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Turret set in "FOCUS" position; Safety Switch Arm not taut; take-up belt off; power line faulty

Trouble	*Probable Cause*
Camera "hunts"	Voltage below 115V 60 Hz AC; camera cold
Film jam	Improper threading; magazine cover not relieved on "dished" roll; perforations incorrectly placed on sprockets
Lens will not focus	Lens not seated in turret; turret not seated properly; lens damaged
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up in the following: aperture plate; sprocket-guide rollers; pressure plate; registration pins; magazine rollers
Sporadic take-up	Belt too loose; belt slipping; power line faulty
Cut-in on telefinder tube	Turret not seated

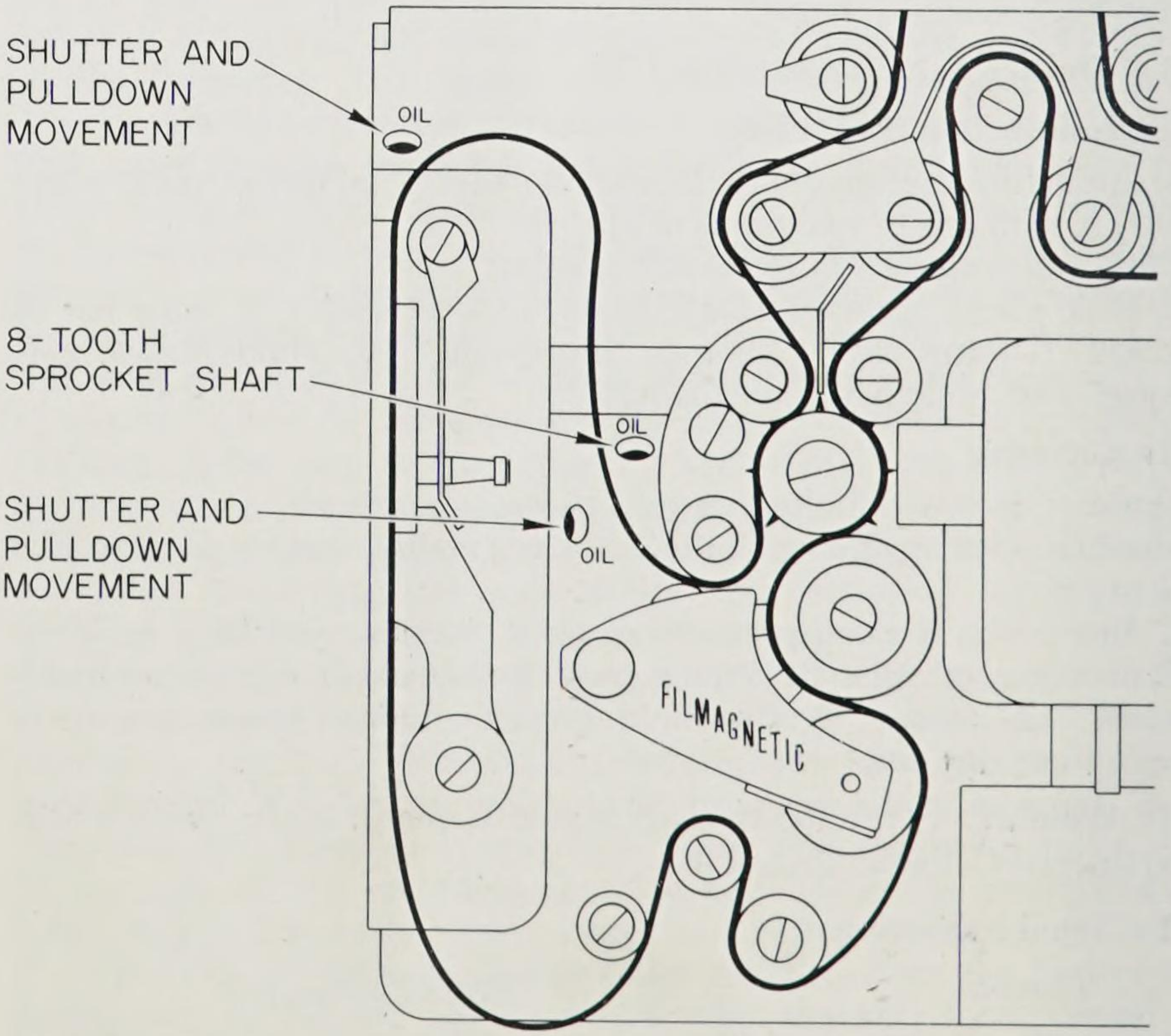


Fig. 11-4. Auricon Pro-600 lubrication. Courtesy of Bach Auricon, Inc.

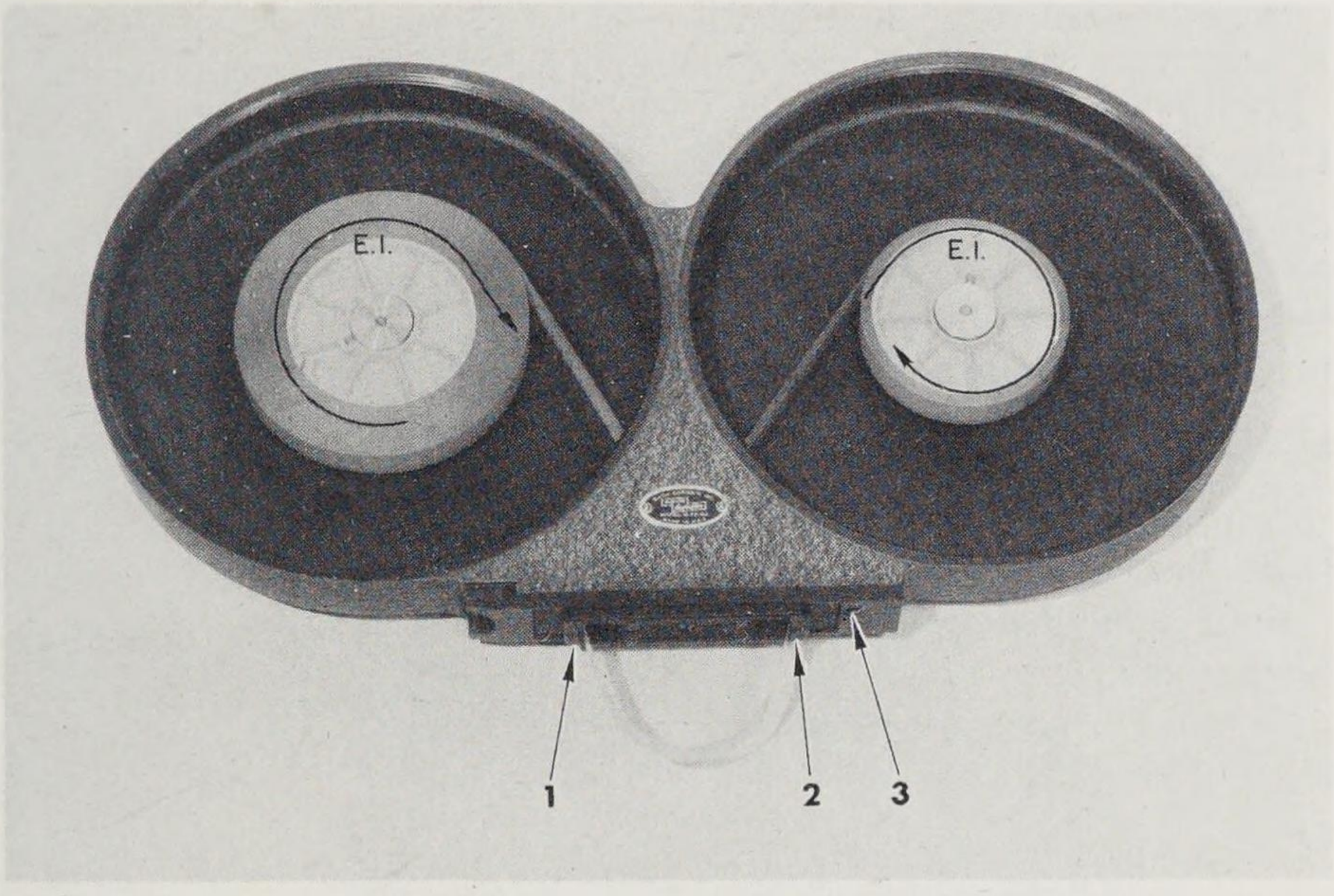


Fig. 11-5. Auricon Pro-600 magazine. Courtesy of Bach Auricon, Inc.

1. Feed light trap
2. Take-up light trap
3. Magazine lockdown screw hole

11.2 AURICON PRO-600 MAGAZINES (Fig. 11-5)

11.2a Type: Double-compartment.

11.2b Capacity: 400-ft and 600-ft (shown).

11.2c Lids: Two. Threaded. To remove, rotate counterclockwise.

11.2d Feed: Left side. Film (wound emulsion in) pulls off spindle clockwise.

11.2e Take-up: Right side. Film winds on spindle clockwise, emulsion always in.

11.2f Loading

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Pull film off roll clockwise. Insert film end to right of light-trap roller and push through until end exits throat. 3. Place roll on feed spindle. Rotate feed-spindle wheel until spindle pin engages the core keyway. 4. Replace feed lid. 5. Unscrew take-up lid in light. Insert film end into take-up side of light trap (outer side of roller). 6. Hold core. Rotate take-up spindle wheel until spindle pin engages the core keyway. 7. Insert film into core slot and wind up on take-up spindle clockwise (emulsion in). 8. Replace take-up lid.

NOTE: (a) Relieving the lid a quarter-turn eliminates "drag" and/or noise of roll which may have "dished" in loading. (b) The 600-ft

magazine center-spindle wheel is mounted *between* the two compartments; the 400-ft magazine center-spindle wheel is mounted on the feed compartment.

11.2g Unloading

In darkness, unscrew take-up lid. Place the middle finger in the core, thumb on edge of roll; turn magazine over, remove film roll, and place exposed roll in black bag and can.

11.2h Footage Counter: None.

11.3 16mm AURICON SUPER-1200 CAMERA (Figs. 11-6, 11-7)

NOTE: All directions are from the Operator's point of view.

11.3a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lockdown screw.

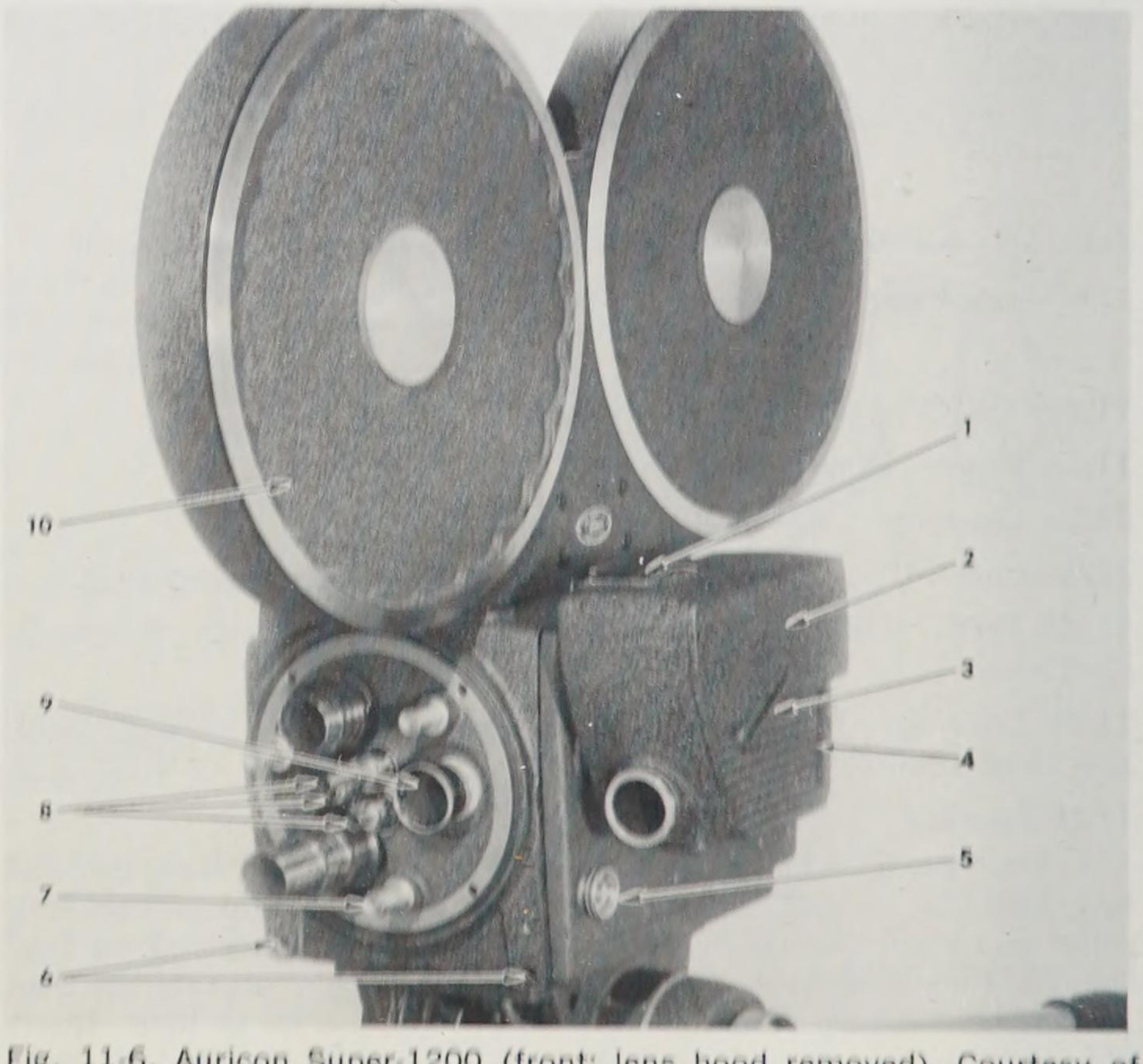


Fig. 11-6. Auricon Super-1200 (front; lens hood removed). Courtesy of Bach Auricon, Inc.

1. Viewfinder-focus indicator/parallax adjustment
2. Viewfinder
3. Matte slot
4. Matte storage
5. Door knob
6. Lens-hood bracket-mounting screw holes
7. Turret-release button position
8. Telefinders
9. Taking lens
10. 1200-ft magazine

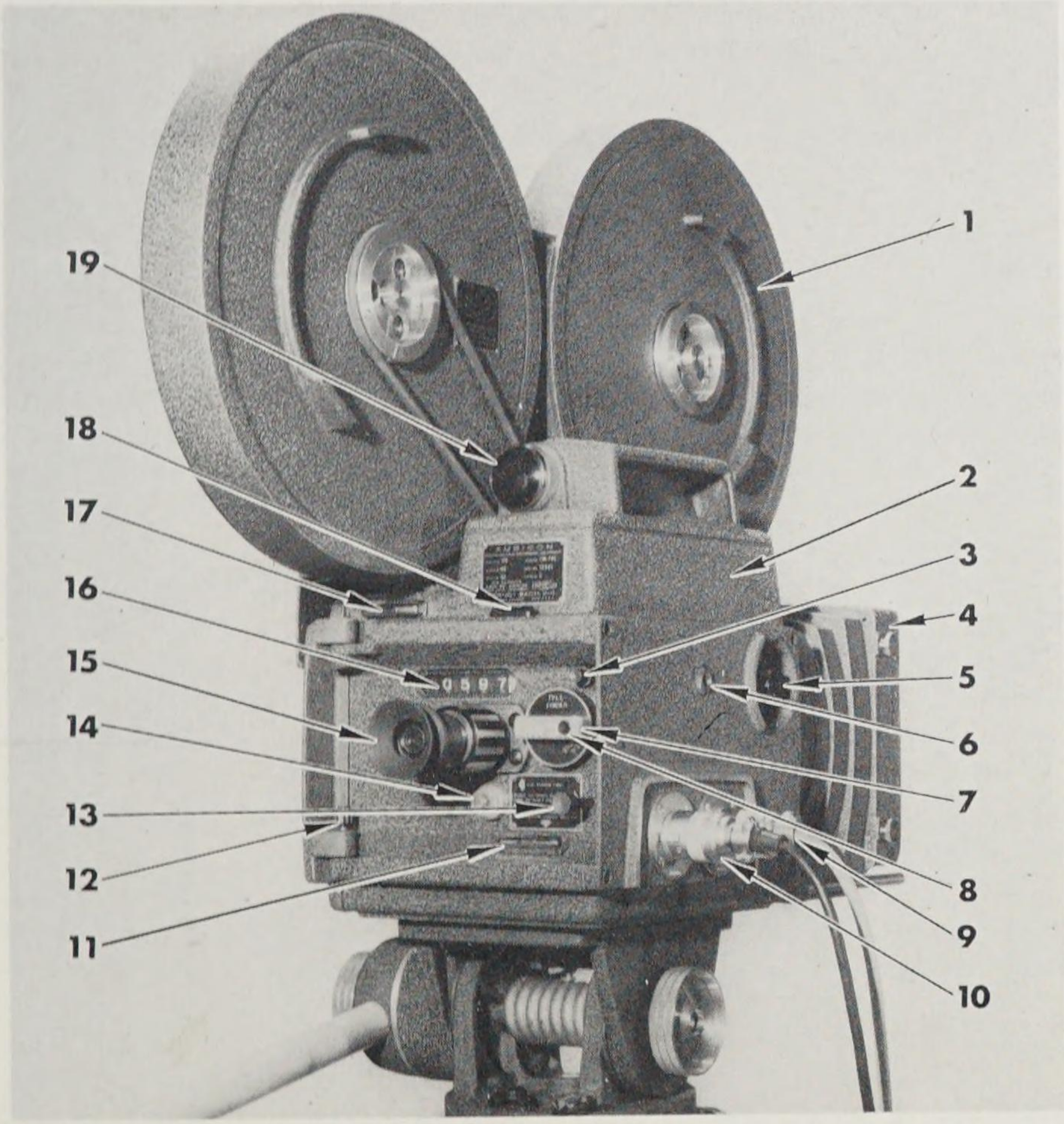


Fig. 11-7. Auricon Super-1200 (rear; lens hood in place). Courtesy of Bach Auricon, Inc.

1. 1200-ft magazine
2. Take-up motor
3. OFF button
4. Lens hood
5. Shutter adjustment knob
6. Optical monitor jack
7. Rackover bar
8. ON button
9. Sound line
10. Power line
11. Neon heater lamp
12. Door thumb nut
13. Shutter-clear plunger
14. AC light
15. Eyepiece
16. Footage and frame counter
17. Buckle-trip warning light
18. Bubble level
19. Rear bullseye (may be voltmeter)

11.3b Rackover

Internal. The Super-1200 rackover system (as opposed to other cameras') consists of moving a prism laterally to a position in front of the aperture. This facilitates sighting through the taking lens.

To rack over: Grasp bar at back of the camera and rotate it counterclockwise until it hits the stop (approximately 10 o'clock). The words "G.G. FOCUS" (groundglass) are upright when camera is racked over.

CAUTION: It is not possible to *start* the camera in the rackover position. However, once the camera is rolling, it *can be racked over* (to "G.G. FOCUS") for a quick check of the scene. In this position, the prism obliterates the aperture and *nothing registers* on the film. It is important to rack back to "TELEFINDER" position!

To rack back: Rotate the bar clockwise to a horizontal position. The word TELEFINDER is upright when camera is racked back, the camera aperture is clear of the prism, and the telefinder is ready for use (see "Telefinders" Sec. 11.3f).

11.3c Focusing tube: Internal. Image magnified 10×.

Eyepiece: At back of camera.

To focus eyepiece: Rack camera over, and rotate scalloped knob forward of the eyecup to achieve focus on the groundglass.

NOTE: With the rackover bar in normal position (the word TELEFINDER upright) the eyepiece is used to sight through the telefinders on the turret. The area viewed is the projector-aperture field with *no* cross hair visible (see "Telefinders" in Sec. 11.3f).

Groundglass: Nonremovable; has cross hair; scribed line inside perimeter of groundglass denotes projector-aperture field.

To clean: Rack over and remove taking lens from turret to expose groundglass face and prism. Insert cotton swab dampened with filtered cleaner provided by manufacturer and clean groundglass face.

11.3d Motors

Camera: 115V AC synchronous. Built-in; nonchangeable; nonreversible.

Take-up: Built-in; nonchangeable; nonreversible. When AC line is hooked up to the camera, the take-up motor applies one-third power to the take-up belt only. The belt in turn provides tension on the threaded film, which, looped around the Safety Switch Arm roller (see Fig. 11-8), pulls the arm forward and permits the camera to run (see Sec. 11-3n).

NOTE: Full power is applied to the take-up belt only when the ON button is pressed.

There are *no* variable-speed, high-speed, or animation motors for the Super 1200.

11.3e Power line

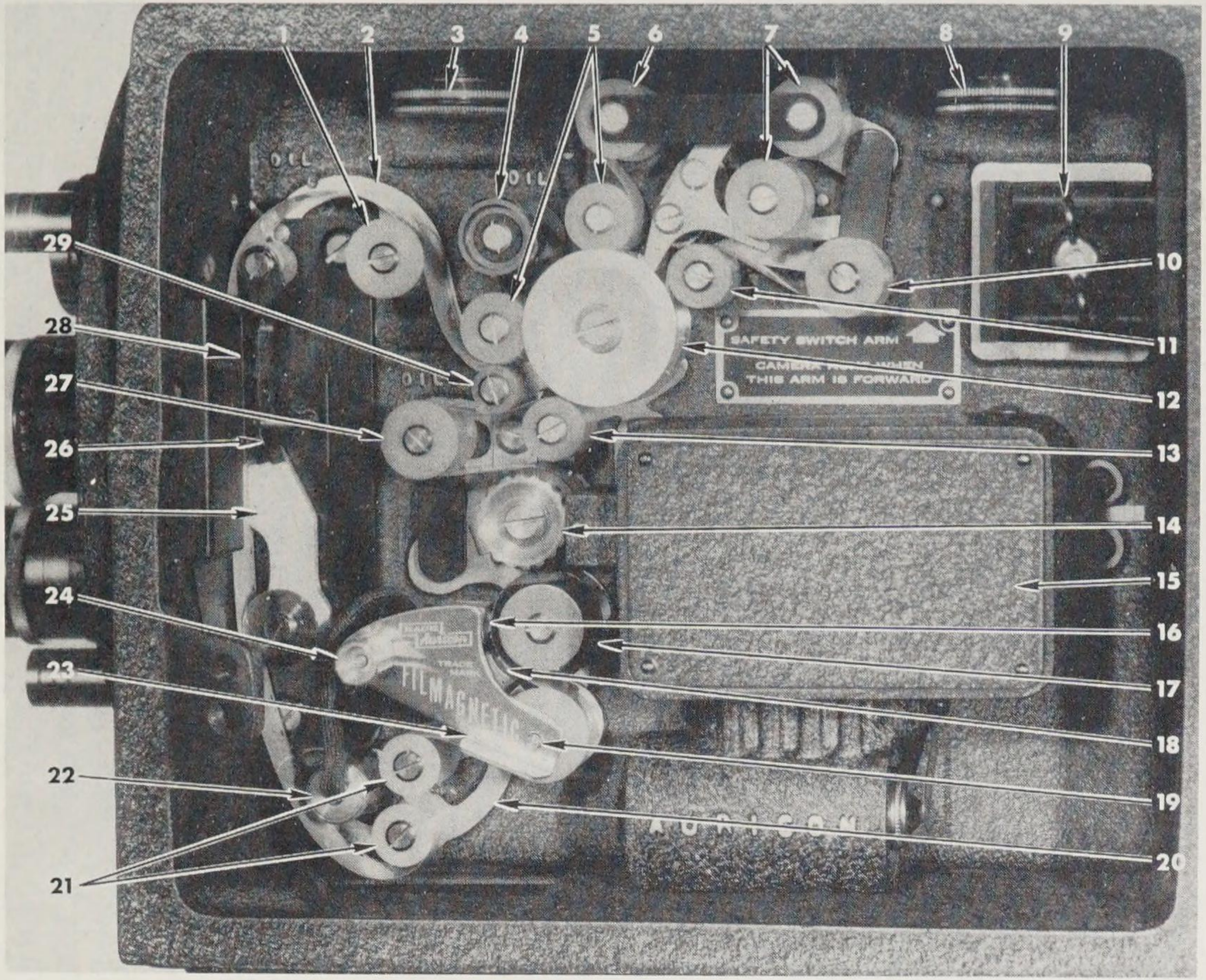
Input to camera: The three-pin Cannon plug AC connector is at the right side of the camera. The eight-pin Cannon plug is for sound.

Amber light (below the eyepiece): Glows to indicate there is AC to the camera.

Phone jack (above the AC and sound Cannon plugs): May be used

Fig. 11-8. Auricon Super-1200 (threading detail—with Filmagnetic unit installed). Courtesy of Bach Auricon, Inc.

1. Upper-loop roller
2. Loop guide
3. Magazine lockdown screw
4. Red hex nut
5. Sprocket-guide rollers
6. Top feed roller
7. Take-up rollers
8. Magazine lockdown screws
9. Footage and frame counter knob
10. Buckle-trip (Safety Switch Arm)
11. Fixed sprocket-guide roller
12. 12-tooth feed and take-up sprocket
13. Large separator roller
14. 8-tooth recording sprocket
15. Galvanometer
16. Reproduce head
17. Recording roller
18. Record head
19. Roller-arm pin
20. Loop guide
21. Double rollers
22. Magnetic-head connector plug
23. Retaining-arm push-down tab
24. Scalloped nut on sound unit support arm
25. Pulldown claw protector
26. Pressure-plate retaining spring
27. Vertical film tension roller
28. Pressure plate
29. Small separator roller



to monitor the optical track being recorded in the camera. However, it does *not* monitor a magnetic track.

ON/OFF buttons: Located at the back of the camera. Black button on the rackover bar = on; red button above rackover bar = off.

Neon heater light: Located at back of take-up motor housing. It glows to indicate the internal thermostat control is on. The heater turns on whenever the camera temperature is below 65°F and may remain on until camera temperature reaches about 80°F. Light extinguishes when the camera rolls. The neon heater lamp is non-changeable; replacement of the entire lamp unit is required when burned out.

Red "bullseye" lamp (at front of take-up motor housing): Along with tubular *pilot light* (below rear of magazine), in series with a *voltmeter* at the back of the take-up motor housing. The AC voltmeter reads in increments of 10 volts. To indicate low voltage, 0–109 volts are marked in red; 110–150 volts are marked in green to indicate proper voltage to motor. All work when camera runs.

NOTE: Earlier models may have a red "bullseye" in place of the voltmeter to indicate the camera is running.

To change bulbs: Amber AC power indicator and red "bullseye": unscrew plastic lamp housings; depress and rotate bulbs counterclockwise and remove.

11.3f Turret

Three-position. The lens directly next to the viewfinder is the taking lens. Turret accommodates C-mount lenses. Each lens port has a corresponding telefinder port.

To rotate: Press the lowest turret-release button (located at 6 o'clock). Rotate turret until desired lens locks into taking position.

Telefinders: Telefinders are manufactured in sizes from 10mm to 150mm, to match lenses of corresponding focal length. They are particularly advantageous for use with the telephoto lens (75mm and longer) when the opening in the plastic viewfinder matte becomes too small to view the object being photographed. When viewed through the eyepiece, the image is magnified 10×. The field of the telefinder must be aligned with the field of the taking lens before it can be used.

To mount and align telefinder:

1. Select a telefinder with a focal length corresponding to that of the taking lens. 2. Remove the three hex-head screws and coverplate from the telefinder socket, horizontally opposite the taking lens. 3. Insert the telefinder ball mount into its socket, flush with the flange. Insert and hand-tighten the three coverplate screws into the flange. 4. Rackover. Sight through the eyepiece and align the taking-lens field with an object. 5. Rackback. Sight through eyepiece and adjust the three screws until the telefinder-framing field is in alignment with the taking-lens field. Tighten screws securely.

11.3g Lenses

To mount: Insert C-mount of lens into threads in turret port. Rotate counterclockwise until snug fit is obtained.

11.3h Viewfinder

Offset. Permanently installed on camera door. Manufacturer calls the viewfinder autoparallax, which means that as the focus indicator at the top of the viewfinder is moved to a specific distance on the scale, the field of the viewfinder shifts automatically into correct parallax.

Utilizes plastic mattes. Does not have a cross hair. A full complement of plastic mattes may be carried in a holder at the side-rear of the finder. The matte corresponding to the lens in use is inserted into the angled holder at the front side of the viewfinder. The matte is inserted with the focal-length numeral on its tab upright and visible to the Operator. A properly inserted matte will have only its tab showing. Notches in the matte prevent upsidedown or backward insertion.

Full field of the viewfinder without a matte corresponds to a 17mm lens field on 16mm cameras. (If viewfinder is utilized on a 35mm camera, the full field corresponds to a 35mm lens).

Focus: Indicator at top of viewfinder moves from 4 ft to infinity.

Parallax adjustment: Set focus indicator at top of viewfinder to correspond to the focus setting on the taking lens.

> CAUTION: The viewfinder and lens are *not* coupled. After focusing the lens, the viewfinder must be focused manually.

Frame-line adjustments: If the viewfinder *top and bottom* frame lines do not match the camera-aperture top and bottom frame lines:

1. Insert a focusing prism into the camera gate (it is more accurate than sighting through the rackover position). Set the taking lens at infinity. Align the aperture top and/or bottom frame line with a horizontal object. Close the camera door. 2. Set the footage indicator at infinity. Remove six screws and the side plate from the viewfinder. Slide the rear window out of its notch. 3. With an Auricon wrench, loosen the socket set screw located at the right side, forward of the window notch. Rotate the knurled adjusting knob below the window notch until the image in the viewfinder matches the image in the aperture. Tighten the socket set screw, and replace the window and the side of the viewfinder.

If the viewfinder *side lines* do not match the camera-aperture side lines after the footage indicator at the top of the viewfinder has been set to match the footage set on the lens:

1. Insert a focusing prism into the aperture gate (it is more accurate than sighting through the rackover position). Set the lens at the subject focus, align the aperture field with the subject, and close the camera door. 2. Set the viewfinder footage scale to coincide with the focus set on the lens. 3. Remove the cover plate from the bottom of the viewfinder and loosen the two cam-locking screws at the front of the cam

plate. 4. Slide the cam plate forward or back until the image in the viewfinder is in parallax-corrected position for the distance set on the viewfinder footage indicator, which should coincide with the focus set on the lens. Rotate the cam-locking screws until snug. 5. Compare the viewfinder-field alignment with the image in the focusing prism. If satisfactory, tighten the cam-locking screws.

11.3i Lens hood/sunshade

Lens hood: Unit "blimps" the turret to eliminate camera noise that might be transmitted through the lenses. Hood mounts on two rods that fit into a bracket.

The arc-shaped bracket is independent of the camera, has two knurled-head screws that insert into tapped holes in the bottom front of the base. The hood slides in and out only.

To clear lens hood from turret: Depress the spring-release catch in the left rod channel. Slide the hood forward. Let go of the spring-release catch so that it can drop into forward depression in rod.

To remove hood: Depress the spring-release catch in the forward depression on the left rod and pull hood off.

Sunshade: Collapsible. Unit mounts to lens hood by inserting notches at rear of sunshade under the four knurled screws on the hood. Sunshade is open at the left side to provide unobstructed viewing area for the viewfinder.

11.3j Filters: Fitted to individual lenses. No holders or internal slot.

11.3k Door: Two types available: (1) autoparallax and (2) zoom.

Autoparallax: Fitted with tapped holes and a mounted viewfinder.

Zoom: Plain door with *no* tapped holes or fittings for mounting a viewfinder. Both door types are hinged at the back.

To open: Rotate knurled knob, at front of door, counterclockwise.

To change door: Remove scalloped thumb nut on bottom-rear hinge and lift door straight up and off.

11.3l Magazine: 1200-ft.

To mount:

1. Pull a film loop from the magazine feed side. 2. Insert magazine toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 3. Lower magazine until tapped holes in the magazine toe and heel align with two magazine lockdown screws (at top of camera interior). Rotate screw knobs clockwise to secure magazine. Thread camera (see Sec. 11.3m).

CAUTION: Never place the take-up belt on a magazine that has not been threaded. The one-third power on the take-up motor (see Sec. 11.3d) will pull the film into the take-up side of the magazine.

11.3m Threading (Fig. 11-8)

NOTE: The lower loop of a threaded camera varies, depending on whether optical or magnetic sound system is used. Camera is fitted with interchangeable heads. This interchangeability constitutes what

manufacturer calls "Filmagnetic" system. Older cameras, unless customized, do not have the Filmagnetic feature. All cameras that have been prepared for Filmagnetic are equipped with a removable set of lower-loop rollers. The retaining arm that holds these rollers in place bears the name "Filmagnetic."

To replace optical with magnetic head:

1. Unscrew scalloped nut on sound-unit support arm. Remove the flat retaining arm (stamped "Filmagnetic"). Pull optical roller-arm unit straight out. 2. Insert four-pin male plug of magnetic connector into camera body plug making certain to align yellow dots on plug and camera. 3. Slide magnetic head onto support arm as far as it will go. 4. Place rectangular hole of "Filmagnetic" retaining arm onto matching key of spindle. Depress retaining arm to engage roller-arm pin on right hole of retaining arm. Unit will snap up. 5. Engage scalloped nut on support arm.

To replace magnetic head with optical head: Reverse the procedure outlined above.

To thread camera:

1. Lift pressure-plate retaining spring. Remove pressure plate and set it on bottom of camera interior below gate.

NOTE: Manufacturer states it is not necessary to remove the pressure plate when threading. This is true. However, experience in the field substantiates the belief that removal of the unit allows more thorough checking of plate and aperture cleanliness and quicker pulldown-claw engagement of the film.

2. Slide pulldown-claw protector toward rear of camera to reveal single pulldown claw. Rotate scalloped eight-tooth recording sprocket until claw retracts from gate. Release claw protector. 3. Pull film from magazine feed side. Extend film loop to right front of camera (a rough guide for amount of film needed for threading). 4. Rotate red hex nut counterclockwise to move two sprocket-guide rollers away from sprocket. Insert film: (a) to the left of the top feed roller; (b) between the two sprocket-guide rollers and 12-tooth feed–and–take-up sprocket and over the small separator roller. Rotate red hex nut clockwise and close sprocket-guide rollers on feed–and–take-up sprocket. (c) Loop film to conform to curvature of upper raised-metal loop guide on interior of camera. Place film over upper loop roller. 5. Pull pressure-plate retaining spring back and insert film into gate. Drop pressure-plate retaining spring. Slide pulldown-claw protector back. 6. Rotate eight-tooth recording sprocket until claw enters gate and engages film perforation. Release claw protector. Raise pressure-plate retaining spring; insert pressure plate (small pin up) and lower the retaining spring so that notch engages finger grip of pressure plate. 7a. *Standard optical track–lower loop:* Conform lower loop to curvature of raised-metal loop guide. Depress pushdown tab on retaining-arm plate to separate optical roller from recording sprocket. Insert film to right of optical roller and *between* the large lower sprocket-guide roller and

recording sprocket. 7b. *Magnetic track–lower loop:* Loop film to right of lower double roller, then over upper double roller. Depress push-down tab on Filmagnetic plate to separate the record and reproduce heads from recording roller. Insert film between record and reproduce heads and recording roller. Adjust film so that lower loop clears bottom of camera by 1/8 in. 8. Insert film to right of eight-tooth recording sprocket and under large separator roller, then to left of vertical film-tension roller arm and back under small separator roller.

WARNING: It is important that the film hold the vertical film-tension roller arm in a vertical position (or slightly leaning to the right) to provide proper film flow.

9. Loop film over large separator roller and to the right of the 12-tooth feed–and–take-up sprocket, then to the left of the fixed sprocket-guide roller. Wind film to the right of Safety Switch Arm (buckle-trip). Loop back to left of lower take-up roller, then to right of upper take-up roller. 10. Remove slack on take-up core. Engage belt on take-up and center spindle wheels.

NOTE: Neoprene belt is designed to fit 400-ft, 600-ft, and 1200-ft magazines.

11. Rotate recording sprocket and observe film being transported in camera. If satisfactory, apply power in short bursts and observe action of film. If satisfactory, stop camera, reset footage counter, close door.

11.3n Buckle-trip

Manufacturer calls it "Safety Switch Arm." Spring-tension roller located left of footage counter knob and above galvanometer, cuts out power when arm is toward rear of camera or when film fails to take up.

To run camera without film: Push arm forward, insert wedge between roller and interior of camera.

Buckle-trip warning: Cameras manufactured prior to 1963 have a buzzer that is activated when the Safety Switch Arm drops toward the rear of camera. On later cameras, a pilot light (located below the magazine–see Fig. 11-7) goes out when the Safety Switch Arm drops toward the rear of camera.

11.3o Footage and frame counter: At back of camera. Additive.

Footage counter: Registers each foot, 0–9999, then reverts to zero and counts forward again. Counter may be reset to zero each time magazine is changed.

Frame counter: Registers 0–39 frames, then reverts to zero.

Reset knob (for both counters): Located inside camera above galvanometer.

11.3p Tachometer: None.

11.3q Shutter

Variable; 0–173°. Scalloped shutter-adjustment knob located forward on camera right side (Fig. 11-7). Shutter can be set in five positions only. Calibrations also give shutter speeds at 24 fps. Open, 1/50

sec; 3/4, 1/75 sec; 1/2, 1/100 sec; 1/4, 1/200 sec; closed, 0.

To change shutter opening: Pull scalloped knob; rotate nib on indicator knob to desired shutter opening and shutter speed on 24 frame-per-second index; and push knob in to lock.

Fade-in or fade-out: Achieved by keeping scalloped knob pulled out and rotating the knob counterclockwise to fade-in, clockwise to fade-out.

To clear shutter from focusing tube: Stop camera. Rack over and push green plunger (below rackover unit) *in.*

CAUTION: Do *not* push plunger in while camera is running!

11.3r Lubrication (Fig. 11-9)

Manufacturer recommends lubrication of the following parts every 10,000 ft with one or two drops of oil:

Four holes marked in red inside camera:

1. Hole above large sprocket (12-tooth sprocket shaft). 2. Hole above film-tension roller arm (pulldown movement). 3. Upper hole

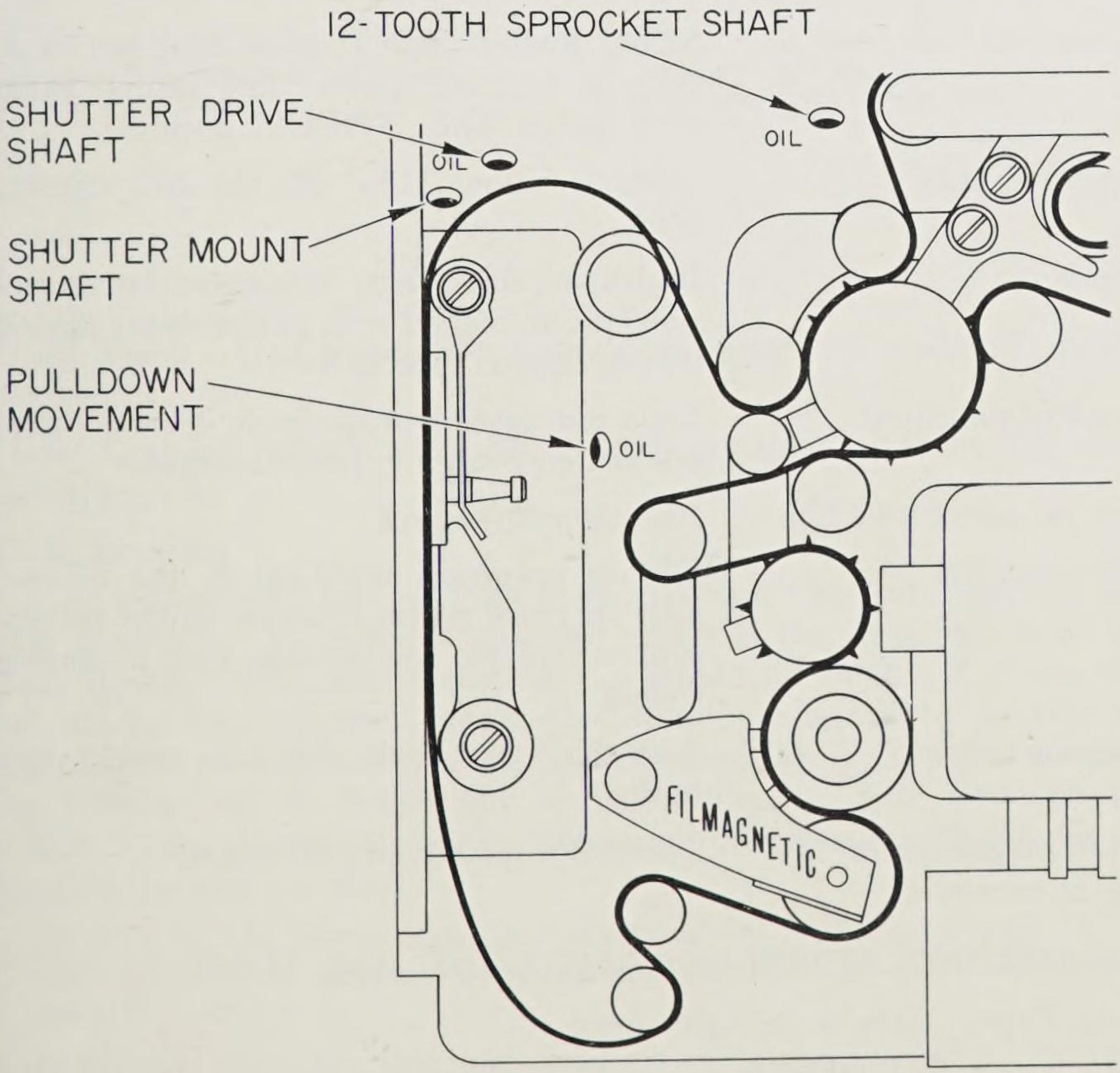


Fig. 11-9. Auricon Super-1200 lubrication. Courtesy of Bach Auricon, Inc.

above gate (shutter drive shaft). 4. Lower hole above gate (shutter mount shaft).

Turret: Remove lens from right side of turret. Rotate turret slowly until the upper (shutter drive shaft) oil hole and/or the lower (pull-down-movement) oil hole behind the turret appears in the lens port.

11.3s Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance each time film is changed:

1. Remove and clean pressure plate. 2. Remove emulsion build-up with orangewood stick. 3. Wipe gate with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on interior of camera to remove dust, dirt, etc.

11.3t Weight: (with 1200-ft load) 51 lb.

11.3u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Safety Switch Arm (buckle-trip) not taut; take-up belt off; power line faulty; rack-over bar in "G.G. FOCUS" position
Camera "hunts"	Voltage below 115V 60 Hz AC; camera cold
Film jam	Improper threading; magazine cover not relieved on dished roll; perforations placed incorrectly on sprocket(s)
Lens will not focus	Lens not seated properly in turret; turret not seated properly; lens damaged
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up in the following: aperture plate; sprocket-guide rollers; pressure plate; registration pin; magazine rollers
Sporadic take-up	Belt too loose; belt slipping; power line faulty
Cut-in on telefinder tube or rackover	Turret not seated; shutter not open

11.4 AURICON SUPER-1200 MAGAZINE (Fig. 11-10)

11.4a Type: Double-compartment.

11.4b Capacity: 1200-ft.

11.4c Lids: Two. Threaded.

To remove: Rotate lid counterclockwise.

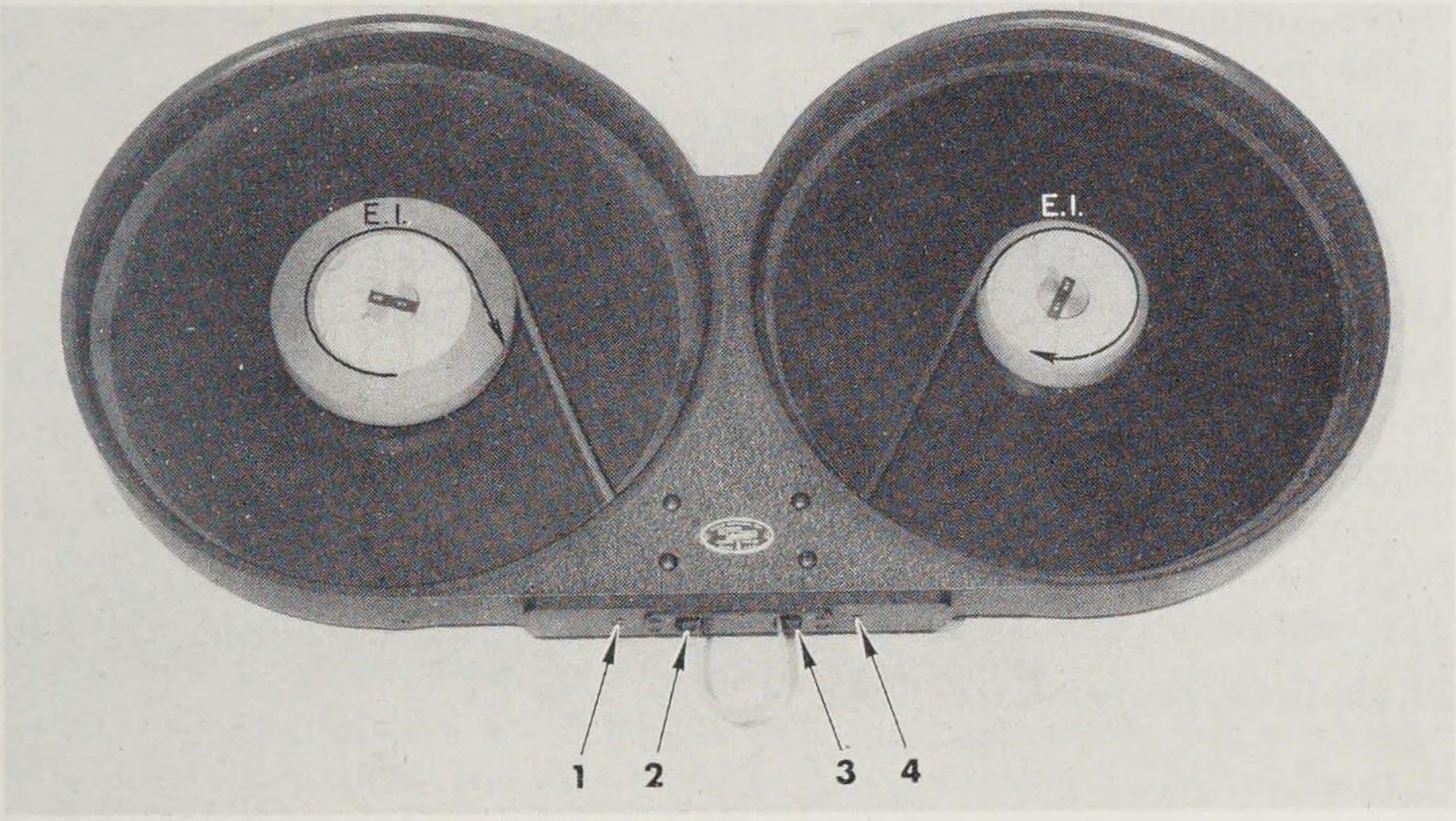


Fig. 11-10. Auricon Super-1200 magazine. Courtesy of Bach Auricon, Inc.

1. Forward lockdown screw hole
2. Feed light trap
3. Take-up light trap
4. Rear lockdown screw hole

11.4d Feed: Left side. Film (wound emulsion in) pulls off spindle clockwise.

11.4e Take-up: Right side. Film winds on spindle clockwise, emulsion always in.

11.4f Loading

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Insert film end between the two rollers in the feed light trap and push through until film end exits the magazine throat. 3. Place film roll on the feed spindle. Rotate feed-spindle wheel until spindle pin engages the core keyway. 4. Replace the feed lid. 5. In light: unscrew the take-up lid. 6. Insert film end into take-up side between the rollers. 7. Place core on spindle. Rotate spindle wheel until spindle pin engages the core keyway.

NOTE: A 3-in. metal core (manufactured by Auricon), a type "Z," "K," or "CNP-3" plastic core is recommended for use on the take-up spindle.

8. Insert film into core slot and wind up on take-up spindle clockwise (emulsion in).

NOTE: Some magazines may have a take-up turning flange, i.e., a circular metal plate slightly smaller than the inside diameter of the

compartment, that acts as an edge guide in the take-up of film on the core.

9. Replace take-up lid.

NOTE: Relieving the lid a quarter-turn eliminates "drag" and/or noise of a roll which may have "dished" in loading.

11.4g Unloading

In darkness, unscrew take-up lid; place index finger on core, thumb on edge of film roll; turn magazine over, remove film roll, and place exposed roll in black bag and can.

NOTE: Auricon 3-in diameter metal cores are not removable from the center of the exposed roll. Therefore a note to the laboratory should accompany the film requesting that the cores be returned.

11.4h Footage counter: None.

CHAPTER 12

Beckman & Whitley CM16 Camera and Magazine

12.1 BECKMAN & WHITLEY CM16 CAMERA* (Figs. 12-1, 12-2)

NOTE: All directions are from the Operator's point of view.

12.1a Base

Bottom fitted with one ¼"-20 tapped hole and two ⅜"-16 tapped holes to accommodate tripod lockdown screws. Also a special type keyed hole for a Beckman & Whitley tripod mount.

NOTE: The forward ⅜"-16 tapped hole is recommended when using a 400-ft magazine. The rear ⅜"-16 hole is recommended when using a 1200-ft magazine.

12.1b Tripod mount

Used for a quick disconnect from a shoulder-pod to a tripod, or vice versa. The unit is optional. The keyed hole in the bottom of the camera accepts the rectangular base of the mount. The nonthreaded rear pin of the mount is inserted into the ¼"-20 tapped hole at the bottom of the camera. A positive lock pin from the mount is inserted into the keyed forward hole and secured by turning a lock lever in the plate. Base of the mount is fitted with one ⅜"-16 tapped hole for placement on a tripod head.

To release or lock: Rotate lever at side of mount.

12.1c Motor

Built-in; 115V 60 Hz synchronous; nonreversible; operates off 110V AC or portable power pack.

12.1d Power line

Input to camera: Inserted into lower nine-pin Amphenol plug (in back of handgrip, right side). Red dot on input plug is *up* for proper alignment.

ON/OFF switch: Rocker-type, located at right side of camera above handgrip.

Auxiliary ON/OFF switch: Located in power-line cable.

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*Manufacturer states the designation CM is for "Continuous Motion," i.e., the film is guided past the aperture by a registration pin at the rate of 7.2 ips (24 16mm frames, when measured with a ruler, equals 7-2/10 in.; therefore 7.2 ips = 24 fps). In a like manner of tape in a tape recorder passing the sound heads, the film in a CM16 does not halt in its travel to be exposed when the shutter opens (as does film in a conventional camera). Instead, the image is "tracked" onto the film by the rocking mirror. It is this "tape recorder-like" action that gives it the name "Continuous Motion."

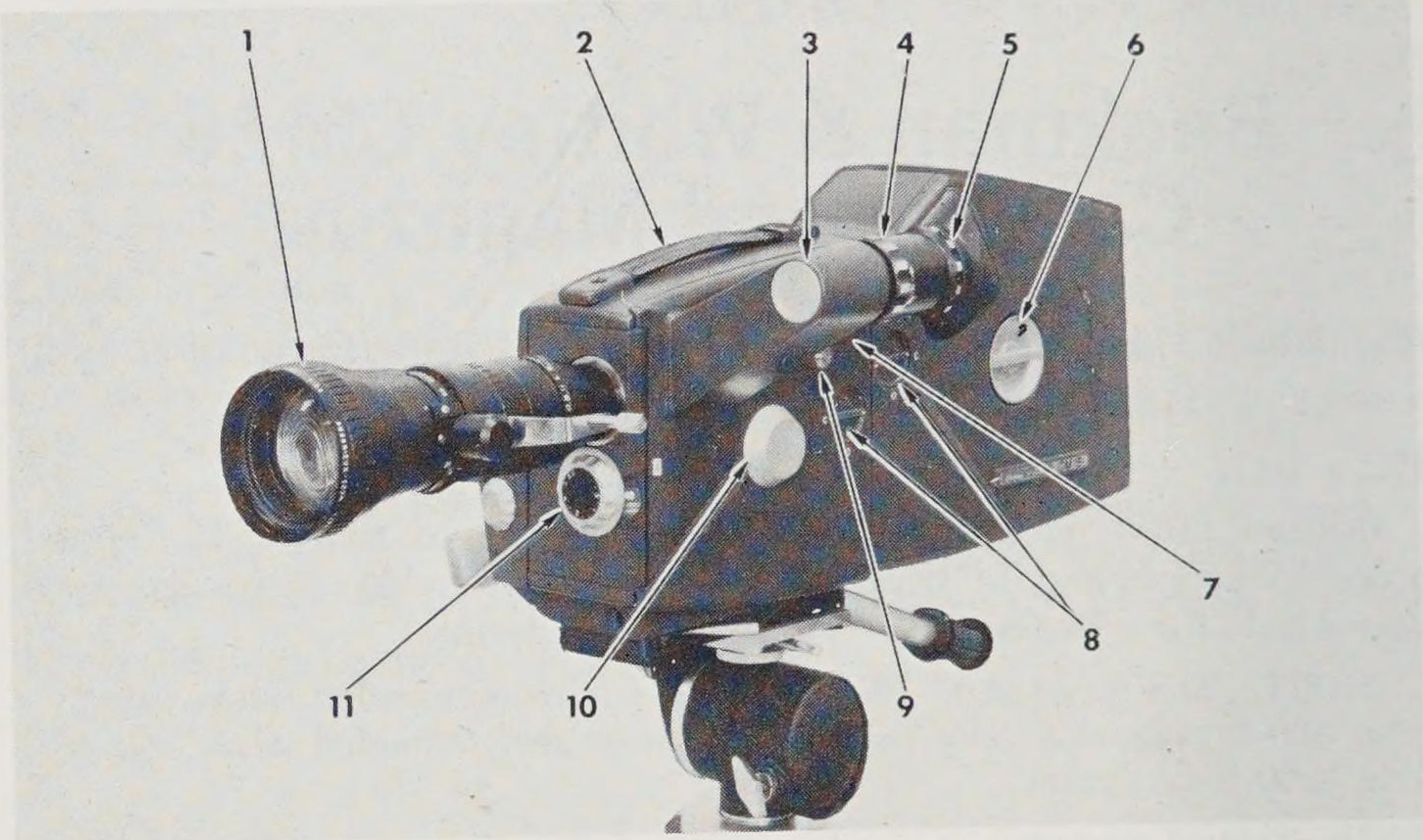


Fig. 12-1. Beckman & Whitley CM16 (left front). Courtesy of Beckman & Whitley, Inc.

1. C-mount zoom lens
2. Carrying handle
3. Reflex viewfinder
4. Light-trap knob
5. Eyepiece focus knob
6. Positive film tensioner
7. Footage counter (not visible)
8. Camera magazine door locks
9. Footage counter reset knob
10. Stroboscopic tachometer
11. Internal iris-control knob

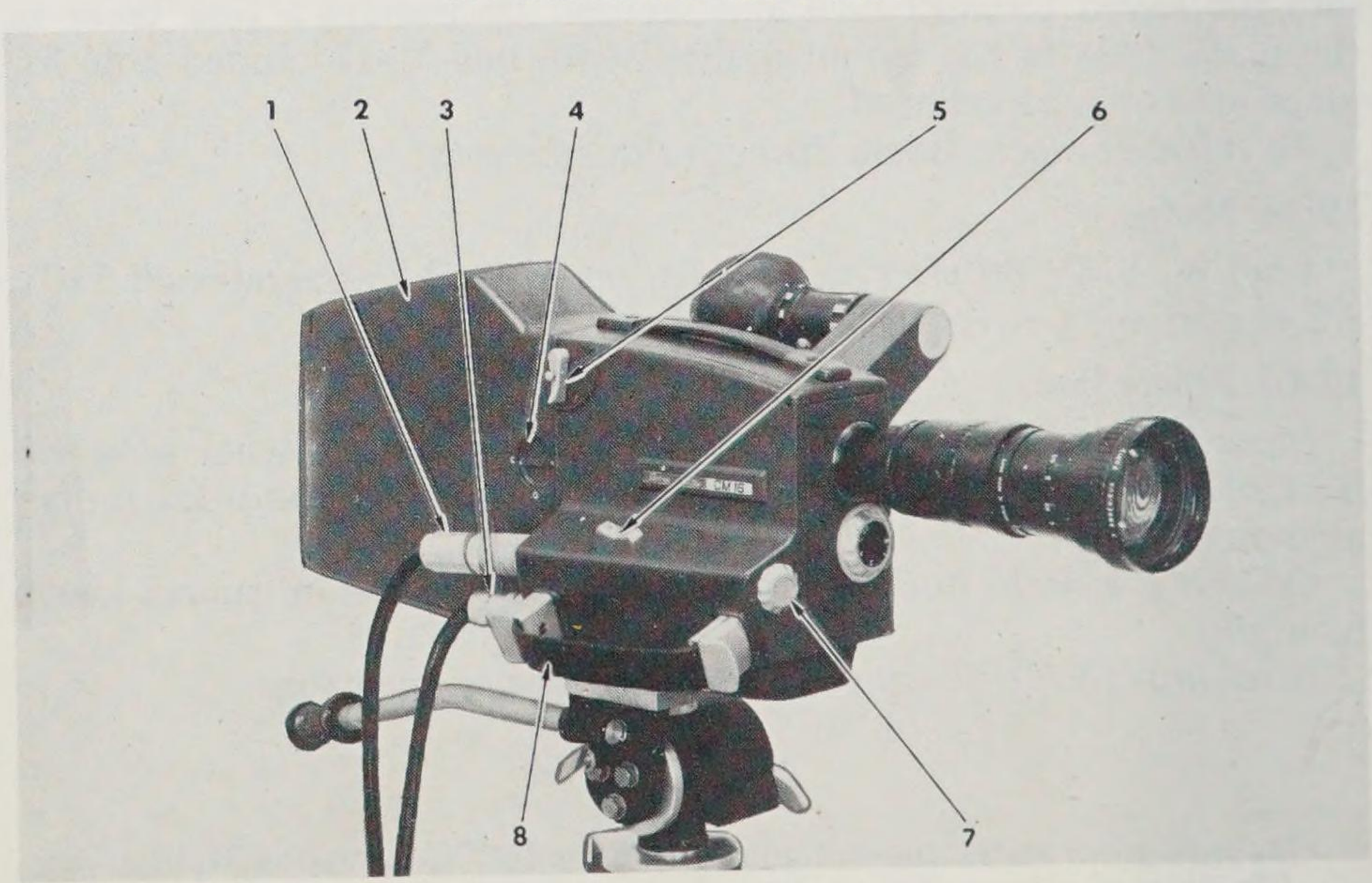
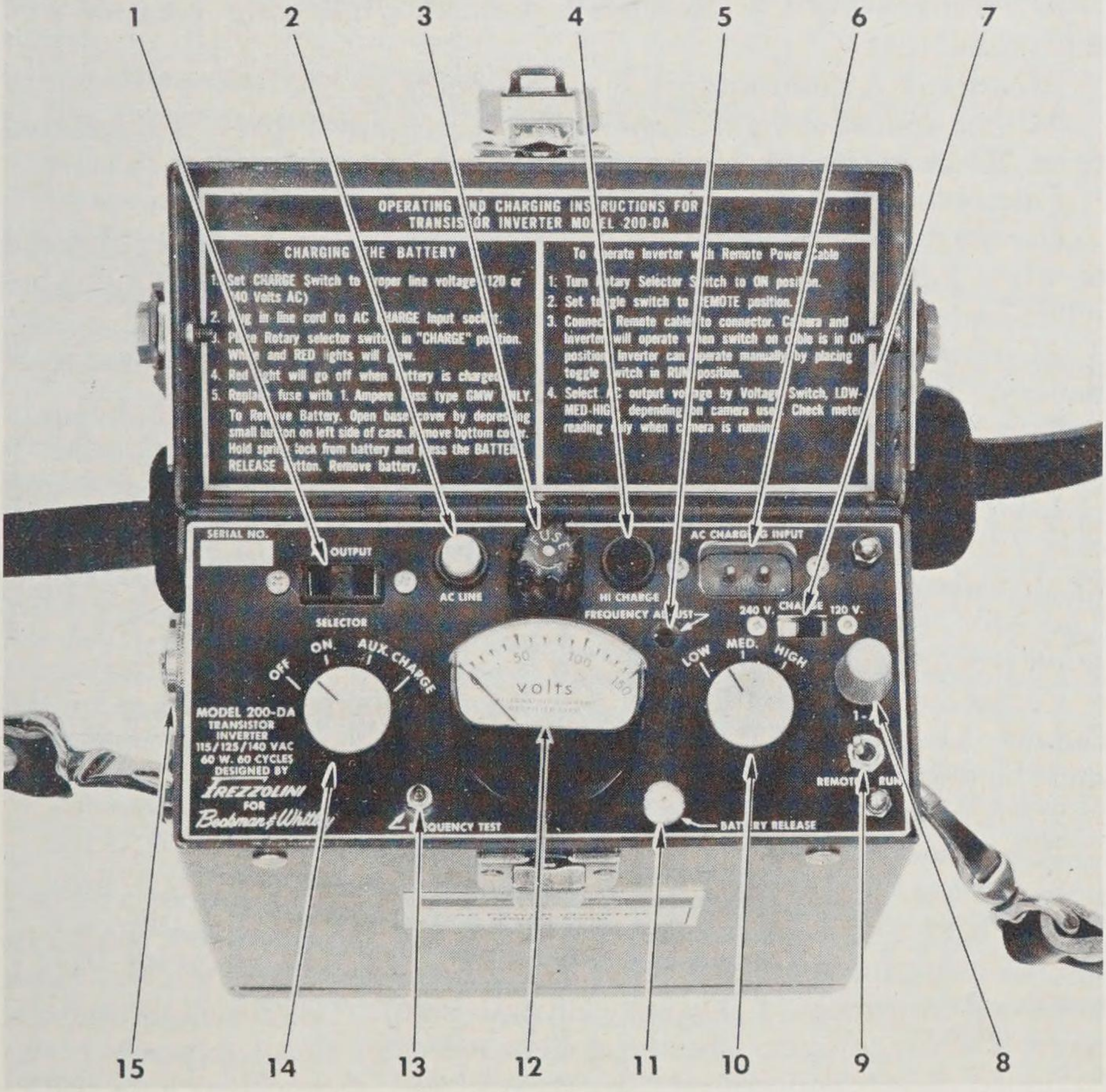


Fig. 12-2. Beckman & Whitley CM16 (right front). Courtesy of Beckman & Whitley, Inc.

1. Sound cable connector
2. 400-ft magazine
3. Power-cable connector
4. Magazine door lock
5. Magazine lock
6. ON/OFF rocker switch
7. Inching knob
8. Hand grip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OPERATING AND CHARGING INSTRUCTIONS FOR TRANSISTOR INVERTER MODEL 200-DA
CHARGING THE BATTERY
1. Set CHARGE Switch to proper line voltage (120 or 140 Volts AC)
2. Plug in line cord to AC CHARGE input socket.
3. Place Rotary selector switch in "CHARGE" position. White and RED lights will glow.
4. Red light will go off when battery is charged.
5. Replace fuse with 1 Ampere boss type GMW ONLY.
To Remove Battery. Open base cover by depressing small button on left side of case. Remove bottom cover. Hold spring lock from battery and press the BATTERY RELEASE button. Remove battery.
To Operate Inverter with Remote Power Cable
1. Turn Rotary Selector Switch to ON position.
2. Set toggle switch to REMOTE position.
3. Connect Remote cable to connector. Camera and inverter will operate when switch on cable is in ON position. Inverter can operate manually by placing toggle switch in RUN position.
4. Select AC output voltage by Voltage Switch, LOW-MED-HIGH depending on camera used. Check meter reading only when camera is running.
SERIAL NO.
OUTPUT
AC LINE
SELECTOR
HI CHARGE
FREQUENCY ADJUST
AC CHARGING INPUT
240 V.
CHARGE
120 V.
OFF
ON
AUX. CHARGE
volts
LOW
MED.
HIGH
MODEL 200-DA
TRANSISTOR
INVERTER
115/125/140 VAC
60 W. 60 CYCLES
DESIGNED BY
FREZZOLINI
FOR
Beckman & Whitley
REMOTE
RUN
FREQUENCY TEST
BATTERY RELEASE
15
14
13
12
11
10
9
8

Fig. 12-3. Beckman & Whitley CM16 power pack. Courtesy of Beckman & Whitley, Inc.

1. AC output
2. AC line indicator light
3. Fuse holder
4. Hi Charge indicator light
5. Frequency adjust
6 AC charging input connector
8. 1-ampere boss fuse
9. Remote/Run switch
10. Power control selector switch
11. Battery release button
12. Voltmeter
13. Frequency test switch
14. Power control selector switch
15. Camera connection-cable plug

Sound cable: Inserted into upper eight-pin Amphenol plug (in back of handgrip, right side). Blue dot on input plug is *up* for proper alignment.

Optional phone jack: Enables Operator to monitor audio across sound head in camera.

12.1e Power pack (Fig. 12-3)

Unit consists of an AC power inverter with a frequency-control module.

AC power inverter: Equipped with the following controls and indicators:

AC output: A multipurpose 115V AC outlet.

AC-line indicator light: Illuminates when power pack is connected to an AC line voltage.

Fuse holder: Takes AGC8 buss-type fuse only.

Hi-charge indicator light: Illuminates when battery is being charged or when camera power (battery or AC) is turned *on*. It extinguishes when battery is fully charged or when camera power is cut.

AC charging input: Accepts an AC line cord to charge power-pack battery.

Power-control selector switch: Four-position—OFF; ON; AUX; CHARGE:

1. OFF: No voltage to power pack. 2. ON: Voltage to power pack only (not camera). 3. AUX: 7.5 volts are switched to two terminals located above the camera power-line Cannon plug at left side of unit. The 7.5V terminals permit a second camera to be operated from the same power pack. 4. CHARGE: To be set when charging battery.

Voltmeter: Registers 0–150 volts. Reads amount of voltage to the camera. Less than 120 volts indicates a low battery. The voltmeter must be read while camera is *running*.

Frequency adjust: To alter frequency to camera.

To adjust:

1. Position the input-voltage CHARGE switch to proper voltage: 120 volts or 240 volts. 2. Connect 110–220V 60 Hz power source to the AC-charging input connector. 3. Turn power-control selector switch to ON. Run camera. 4. Depress FREQUENCY TEST switch and observe *Hi-Charge* light. Flickering light indicates that frequency is unbalanced. 5. *If unbalanced:* Insert insulated screwdriver into FREQUENCY-ADJUST access opening. Engage frequency-adjusting screw and rotate screwdriver slowly until the flickering Hi-Charge light either remains steady or extinguishes totally to indicate the frequency is now balanced.

Charge: Two-position switch: 240 volts or 120 volts. Voltage selection must agree with the AC-input voltage when charging battery.

Voltage-selector switch: When using the camera, set this switch to one of three positions:

1. LOW: When the battery is fully charged (voltmeter reads 120–150 volts). 2. MED: When battery power weakens and/or tachometer varies, or when voltmeter reads less than 120 volts. 3. HIGH: When the tachometer varies in the MED position or the voltmeter reads less than 120 volts.

1-A (fuse cap): Takes a single 1-ampere buss fuse, type GMW.

Frequency test: (See "Frequency Adjust.")

Battery release: Depress battery release button to push battery (also other modules) from case, at the same time press the retainer clip below the panel toward the frequency-control module. (See Sec. 12.1f.)

Remote Run: In REMOTE position, camera is operated from the

ON/OFF camera rocker switch in the handgrip or from camera line switch. In RUN position, camera is operated from the power pack by turning the selector switch to "ON."

Camera connection-cable plug: At left side of the case.

NOTE: It is not necessary to use the power pack if a 115V AC 60 Hz power source is available.

12.1f Modules

Interchangeable units can be installed in the power-pack case to adapt the camera for multiple situations:

Frequency-control module: Standard unit. Used with single system to maintain the power-supply frequency at 60 Hz.

Battery module: One 7.5V nickel-cadmium cell. For portable operation of the camera.

Crystal control module: Used for wireless double system to maintain the power-supply frequency and tape recorder at 60 Hz.

Line-power inverter: Replaces battery. Installation permits use of camera with any input variation of source voltage or hertz ranging from 110–240V AC, 40–70 Hz. Useful in foreign locations where voltage and hertz vary from American standards.

NOTE: The line-power inverter has its own 110–220V switch to correspond to the source voltage, and its own three-position (LOW, MED, HIGH) voltage-level selector switch, thus bypassing the frequency-control module.

CAUTION: If the wrong voltage is applied (i.e., 240 volts instead of 120 volts) the fuse will blow, and the tachometer will not work.

Heater: Maintains camera and magazine at operating temperature when shooting in cold weather. This module clips to bottom of the power pack, and can be used in conjunction with other models.

To change a module:

1. Remove bottom cover from power pack. 2. Depress BATTERY-RELEASE button at top of panel, while pressing the retainer clip (holding the module in place) toward the frequency-control module; remove. 3. Push retainer clip aside; insert new module; replace bottom cover.

12.1g Turret: None. Single C-mount lens port is standard.

12.1h Lenses

The 12–120mm C-mount varifocal (zoom) lens is "standard" lens for camera.

To mount lens to camera: Align threads of lens with mount. Insert and rotate lens to achieve a snug fit.

CAUTION: Camera is equipped with *internal iris control!* (see Sec. 12.1i).

12.1i Internal iris control

Located below the lens port. Calibrated in T stops (T 2.8 to T 22). One-third–stop indicator marks appear between the full-stop indicator

marks down to T 8, only full-stop indications thereafter. A notch in the camera body at the rear of the control permits the Operator to read the T stop setting.

Use of the internal iris control permits the mounted lens to be set at its widest aperture for full brilliance viewing and critical focusing.

CAUTION: The internal iris control is calibrated to compensate for loss of one stop in the internal optics of the camera. Therefore, the mounted lens should be set at its widest aperture and all the T stops *set at the iris control* to assure proper exposure of film.

12.1j Door: Hinged at front.

To open: Rotate door lock counterclockwise to "O" (Open). Pull out from camera body.

To close: Depress catch at bottom of door; close; rotate door lock clockwise to "C" (close).

12.1k Viewfinder

Reflex. Magnifies 12×. Views more than full aperture. Scribe on groundglass indicates full aperture. May be fitted with an optional TV groundglass (pumpkin).

To align reflex mirror for viewing: Depress and rotate inching knob at right front of camera handgrip.

CAUTION: Do not depress knob while camera is running.

To change or clean groundglass: Loosen knurled lock screw in eyepiece and the slotted tracking screw in the eyepiece focus ring. Remove eyepiece. Unscrew the groundglass retaining nut with a spanner wrench. Reinstall with *frosted surface inward*. Align notch in glass with index pin. Insert locking nut to snug fit.

CAUTION: Do not overtighten the locking nut—it will break the groundglass!

Align slot in eyepiece with locating pin, then secure eyepiece in the mount. Align the tracking screw with the slot in eyepiece housing and tighten.

Eyepiece: Rear scalloped knob rotates to achieve focus on groundglass. Knurled screw locks eyepiece at individual's focus.

Light trap: Rotate forward scalloped knob on eyepiece clockwise to close internal iris.

NOTE: Iris does not completely close; a small opening is standard. Manufacturer claims stray light striking rear of eyepiece will *not* "kick back" onto film.

12.1l Sunshade: None.

12.1m Filters

The 12–120mm varifocal lens accommodates a Series 9 glass filter in the lens retaining ring.

Gelatine: Filter slot located in optics cover (inside the camera box —see Fig. 12-4). Filter holder is inserted into slot parallel to camera base, bent side *up*.

12.1n Magazines: 200-ft (not shown), 400-ft (shown), and 1200-ft (shown).

To mount:

1. Pull a film loop approximately 8–10 in. in length from the magazine feed side. 2. Align and rest bottom edge of the magazine on the camera. Draw film loop into camera body. 3. Engage top of magazine to the camera back. Rotate magazine lock lever at the right top of camera rear *down*. Thread camera (see Sec. 12.1o).

To remove: Unthread and break film. Depress button release in magazine lock lever and rotate lock *up*. Pull magazine away.

12.1o Threading (Fig. 12-4)

1. Pull power plug or turn camera power switch "OFF" to avoid accidental starting of camera during threading procedure.

> CAUTION: If power is *not* turned off, camera will run when tension is applied to the rear dampening roller (the run-out switch actuator).

2. Depress pressure-plate safety-stop button; hold; rotate the pressure-plate lock knob counterclockwise and remove assembly from the camera. 3. Clean plate. Check for emulsion build-up on aperture plate and side guides. Replace pressure plate by reversing removal procedure; then rotate the pressure-plate lock knob counterclockwise against the stop button to open gate. 4. Pull film from magazine feed side. Extend loop to right front corner of camera (a rough guide for amount of film needed for threading). 5. Pull pin and rotate film guide toward rear of camera. Insert film: (a) Between roller and buckle-trip. (b) Over the take-up sprocket (milled knob marked "SET LOOP"). (c) Under stationary roller. Close film guide. Over the two back rollers (back one is the rear idler roller, front one is the rear dampening roller). (d) Between the sound drum and the record and playback heads. (e) Over two front sound rollers (rear one is a dampening roller). (f) Down and under the stationary roller, and over feed sprocket. (g) To the left of stabilizing roller into "tape recorder" gate, and under the stationary roller below the gate.

> NOTE: Alignment of a film perforation with the tracking register pin in the gate is not necessary.

(h) Close knurled pressure-plate lock knob (buckle-trip will automatically reset). Push edge of pressure plate inward to verify the seating of pressure plate. 6. Push sound-head retraction pin down to seat film under the sound and record heads. Make certain film is seated in gate and all rollers and sprockets. 7. Rotate loop-tension adjustment ("SET LOOP") clockwise until the rear dampening roller (front one of the two back rollers, also called the "run-out–switch actuator") comes within 1/32 in. of contacting the rear idler roller at top of the film path. Release knob. 8. Rotate tensioner knob on take-up side of magazine to remove film slack. 9. Rotate inching knob at front of camera and observe film being transported in camera.

NOTE: Film will move from bottom to top—this appears to be the

"opposite" of conventional cameras. The Beckman & Whitley optical design presents an upright image at the gate instead of an inverted image.

10. If threading is satisfactory: (a) Retract the sound-recorder arms from the sound head. (b) Apply power in short bursts and observe action of film. If satisfactory, stop camera and close door. Reset footage counter.

12.1p Buckle-trip

Located below the loop-tension adjustment ("SET LOOP"). Cuts

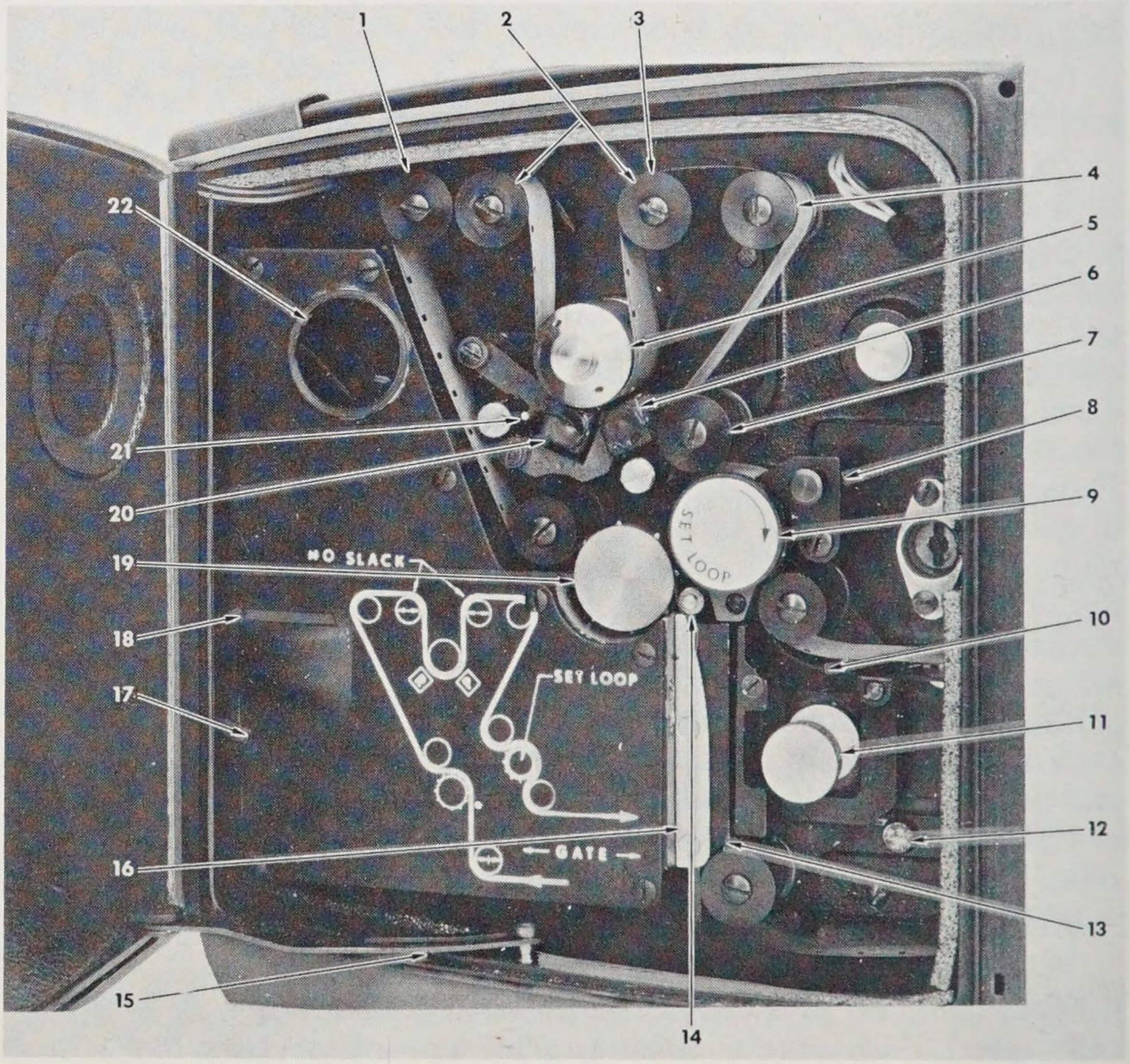


Fig. 12-4. Beckman & Whitley CM16 (threading detail). Courtesy of Beckman & Whitley, Inc.

1. Front idler roller
2. Damping rollers
3. Run-out switch actuator
4. Rear idler roller
5. Sound drum
6. Playback head
7. Stationary roller
8. Film guide
9. Loop-tension adjustment and take-up sprocket
10. Buckle-trip
11. Pressure-plate lock knob
12. Pressure-plate safety stop button
13. Pressure plate
14. Stabilizing roller
15. Door catch
16. Aperture plate
17. Optics compartment cover
18. Filter holder
19. Feed sprocket
20. Record sound head
21. Retraction pin
22. Viewer cover glass

out power when tripped by hand or when film fails to take up. Automatically resets when gate is opened and closed and/or when the buckle-trip arm is pressed down.

Run-out–switch actuator: Rear dampening roller (the front one of the two back rollers) cuts out power when lack of tension permits roller to fall forward. Automatically resets when tension is applied to roller.

To eliminate buckle-trip cut-out if buckle-trip fails to reset: Push run-out–switch actuator down. Rotate screw above actuator until it engages.

12.1q Footage counter

At left side of camera door. Additive. Registers each foot up to 9999 ft, then reverts to zero. May be reset to zero each time magazine is changed.

To reset: Rotate knob below footage counter.

No frame counter.

12.1r Tachometer

On camera door below footage counter. Stroboscopic. .View window permits observation of stroboscopic wheel containing spokes which revolve at 3 revolutions per second. Spokes appear stationary when line frequency is exactly 60 Hz. If spokes appear to rotate, camera is out of synchronism. and requires less or more voltage (see "Frequency adjust" in Sec. 12.1e).

To change stroboscopic tachometer lamp:

1. Open camera door. 2. Remove three screws of tachometer housing from door. 3. Remove old bulb from mounting clip. Replace with new bulb (GE A1-C). 4. Secure housing to door.

12.1s Shutter: Nonadjustable; 170°.

12.1t Lubrication

Manufacturer recommends lubrication of the following parts: Every 1000 ft: one drop of oil on pressure plate. Wipe dry with thumb. Every 25,000 ft: remove eight rollers and lubricate bores with oil-dipped cotton swabs (see Fig. 12-4). Every 50,000 ft: remove drive compartment cover. Lubricate gears (not shown).

12.1u Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove plate and check for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on camera to remove dust, dirt, etc. 5. Sound recorder head—clean every 10,000 ft with dry cotton swab. 6. Friction drives (footage counter and tachometer): check often and remove grease or oil on surfaces.

12.1v Weight: (with 400-ft load) 15 lb; (with 1200-ft load) 22 lb.

12.1w Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; no tension on run-out–switch actuator; power-line connection faulty; power-line or camera switch "OFF"; power-pack switch not set to proper selection; battery dead
Camera door will not close	Film guide on take-up sprocket open; gate not closed; film chip or dirt in door recess
Camera "hunts" (strobe tachometer varies)	Camera not warmed up; voltage variation in line; voltage too low or too high
Film jams	Improper threading; camera and magazine drives not engaged; emulsion build-up in gate
Lens will not focus	Lens improperly seated in mount; eyepiece optics loose; lens damaged
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up in the following: aperture plate; sprocket rollers; pressure plate; magazine rollers
Viewing system blacked out	Shutter closed; light trap closed; lens cap on
Cut-in on viewing tube	Shutter not clear of reflex mirror; internal optics damaged
No take-up, or sporadic take-up	Magazine take-up spindle loose; film loose on take-up core; intermittent power in line
"Wow" or "flutter" on sound phone	Improper tension on dampening rollers; sound heads dirty

12.2 BECKMAN & WHITLEY CM16 400-ft MAGAZINE

(Figs. 12-5, 12-6, 12-7)

12.2a Type: Coaxial.

12.2b Capacity: 400-ft and 200-ft.

12.2c Lids:

Two. Located at each side of magazine, which is divided longitudinally. Both lids lock at front with lip and spring-loaded key. Hinged at back.

To open: Rotate magazine door lock counterclockwise from "C" to "O."

12.2d Feed

Right half. (Latch hook at top, drive gear at top, and transfer rollers

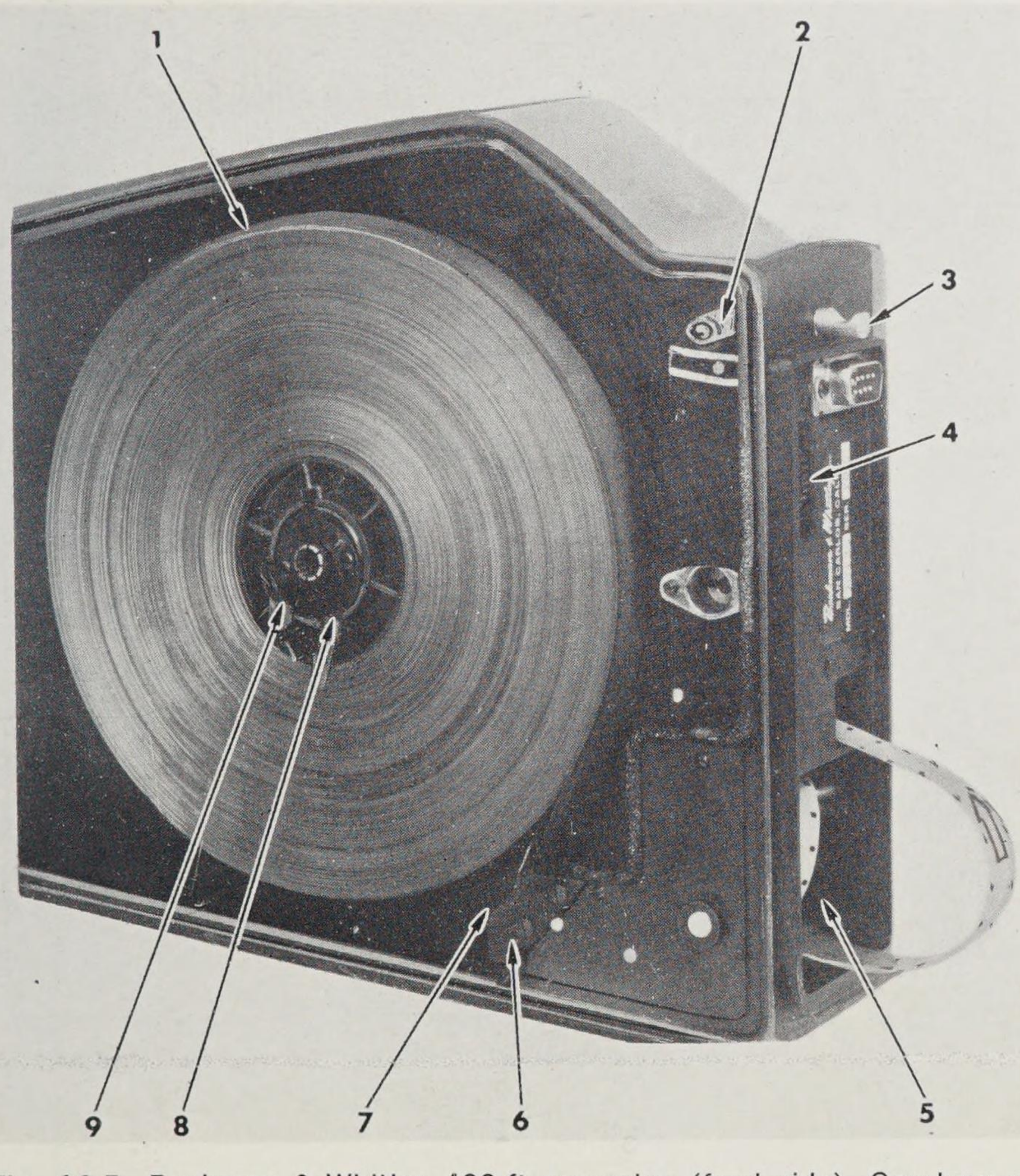


Fig. 12-5. Beckman & Whitley 400-ft magazine (feed side). Courtesy of Beckman & Whitley, Inc.

1. Film roll
2. Adapter storage post
3. Latch hood hook
4. Drive gear
5. Transfer rollers
6. Light trap
7. Feed guide roller (not visibie)
8. Lock tab
9. Core adapter

at bottom should be at the loader's right.) Film (wound emulsion in) pulls off spindle clockwise.

12.2e Take-up

Left half. (Latch hook at top, drive gear at top, and transfer rollers at bottom should be at loader's left.) Film winds on spindle counter-clockwise, emulsion *in*.

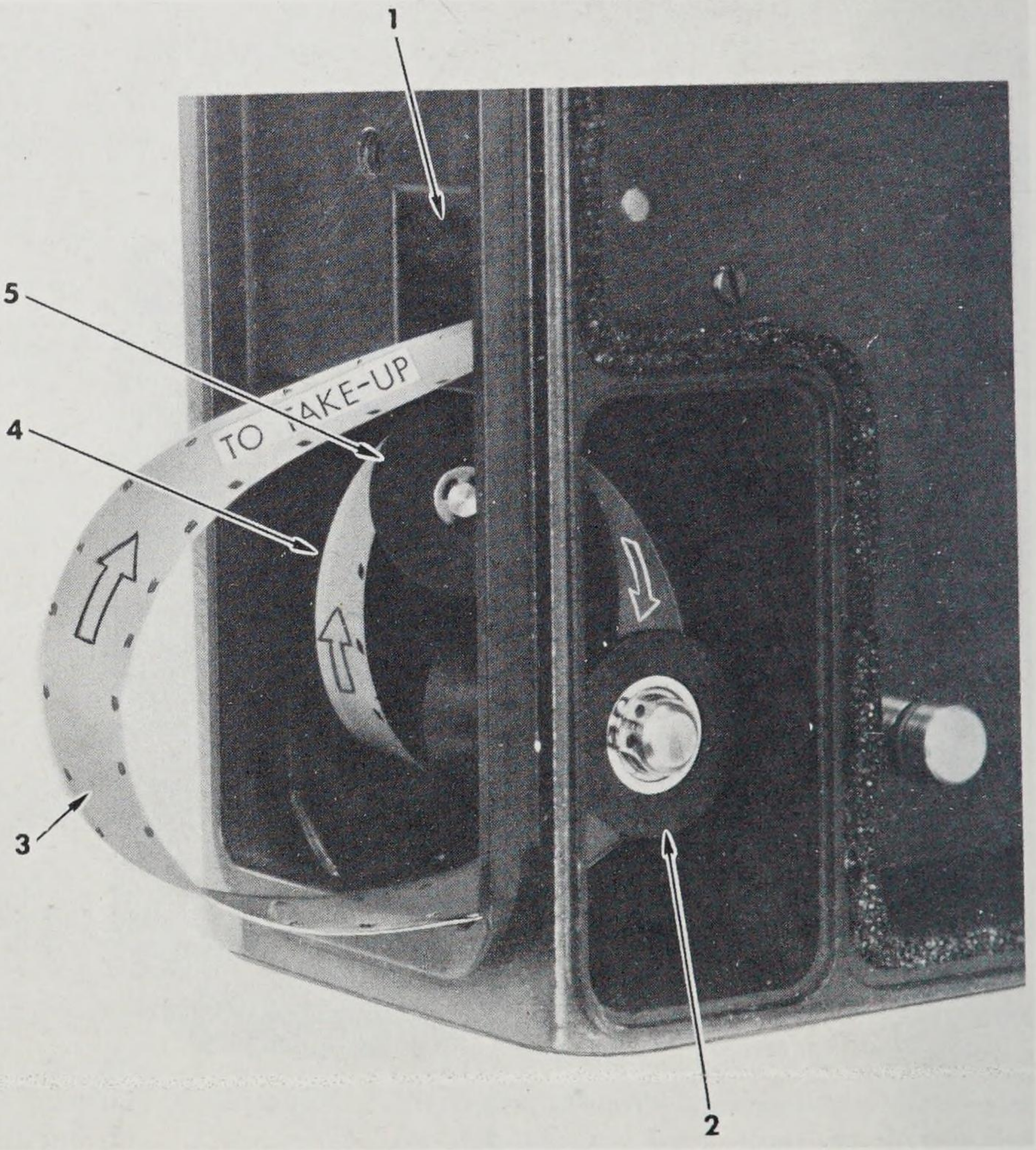


Fig. 12-6. Beckman & Whitley 400-ft and 1200-ft magazine transfer rollers (detail). Courtesy of Beckman & Whitley, Inc.

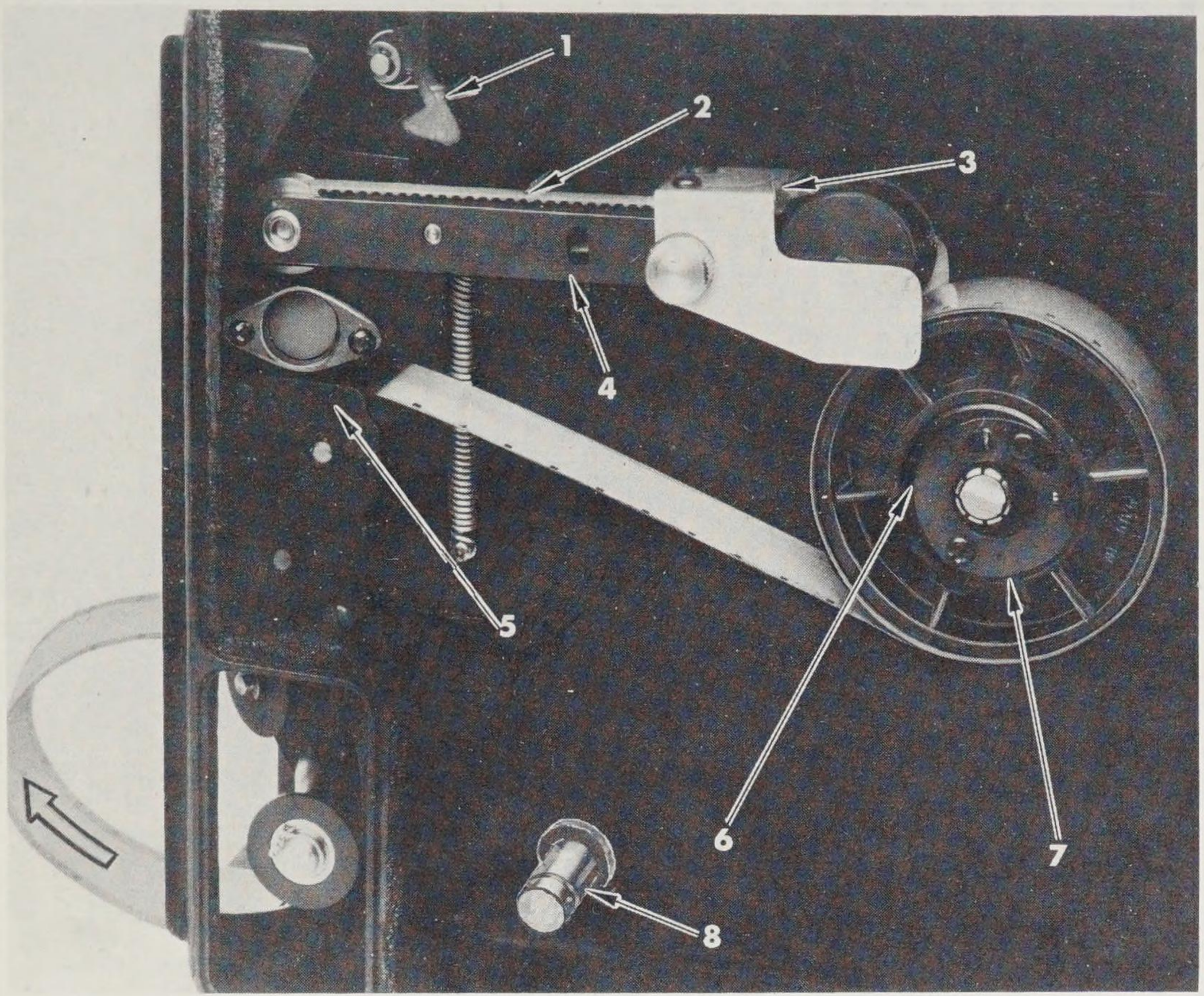
1. Light trap
2. Lower transfer roller
3. Emulsion side
4. Edge-guide post (not visible)
5. 45° transfer roller

12.2f Loading

1. (Fig. 12-5) Rotate feed-lid key lock counterclockwise and open. 2. Rotate circular lock tab on spindle counterclockwise to clear lock tab from spindle. 3. In darkness, remove film roll from can and bag. Insert film end under feed guide roller and through light-trap roller. Push through about 8–10 in. of film. 4. Place roll on the feed spindle so that core engages the ball-type spindle-pin springs and roll is flush

Fig. 12-7. Beckman & Whitley 400-ft magazine (take-up side). Courtesy of Beckman & Whitley, Inc.

1. Drive-arm latch
2. Drive belt
3. Film guide
4. Film drive arm
5. Light trap
6. Core adapter
7. Lock tab
8. Adapter storage post



with top of spindle. Then rotate the lock tab clockwise to secure core to spindle.

WARNING: Camera *will* run without the lock tabs secured. However, the core can "walk off" the spindle and cause a camera jam.

CAUTION: When loading single-perforated film (B-wind), perforations must be inward (away from door) on feed side; outward (toward door) on take-up side (see Fig. 12-6).

5. Replace feed-side lid and secure by rotating lid lock clockwise. Check the lock by attempting to lift lid with fingernails. 6. In light, flip magazine over and open take-up lid. 7. (Fig. 12-6) Form a loop on the 8–10 in. of film and fit loop: (a) Over top of the 45° transfer roller (edge of film should just touch the edge-guide post). (b) Under the lower transfer roller. 8. (Fig. 12-7) Loop film once more and insert end into take-up light trap *above* the transfer rollers. 9. Lift up film drive-arm and engage in drive-arm latch. Rotate take-up–spindle lock tab counterclockwise to clear lock tab from spindle. 10. Insert film into core slot. Place core on spindle locating pin and wind it up on the spindle counterclockwise.

CAUTION: It is important to align film edge with core to ensure even take-up on the core.

11. Rotate spindle lock tab clockwise to secure core to spindle. Release drive-arm catch (push forward) and lower film-drive arm into top of core.

WARNING: Camera *will* run without lock tab secured. However core can "walk off" the spindle and cause a camera jam.

12. Close take-up–side lid and lock by rotating lid lock counterclockwise. Check lock by attempting to lift lid with fingernails. Depress and rotate film tensioner in lid (see Fig. 12-1) counterclockwise to remove slack in take-up.

To load daylight spools:

1. Unscrew core-adapter set screw. Remove adapter and place it on the storage post located at top front of the feed side and at bottom front of the take-up side.

NOTE: The *Standard 400-ft magazine* accepts only a core load on the feed side. It will accept either a core or daylight load on the take-up side. The *Special 400-ft magazine* accepts either a core *or* daylight load on the feed side, a core *or* daylight load on the take-up side.

2. Unscrew the film guide from the film-drive arm and place it on the film-guide storage post at rear of magazine above door latch. Engage film-drive arm in latch.

12.2g Unloading

In darkness, remove take-up lid. Rotate spindle lock tab counterclockwise to clear lock tab from spindle. Place index finger on core and thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

12.2h Footage counter: None.

12.3 BECKMAN & WHITLEY CM16 1200-ft MAGAZINE
(Figs. 12-8, 12-9)

12.3a Type: Coaxial.

12.3b Capacity: 1200-ft.

12.3c Lids

Two. Located at each side of magazine, which is divided longitudinally. Both lids lock at front with lip and spring-loaded key. Hinged at back.

To open: Rotate the two magazine lid locks from "C" to "O."

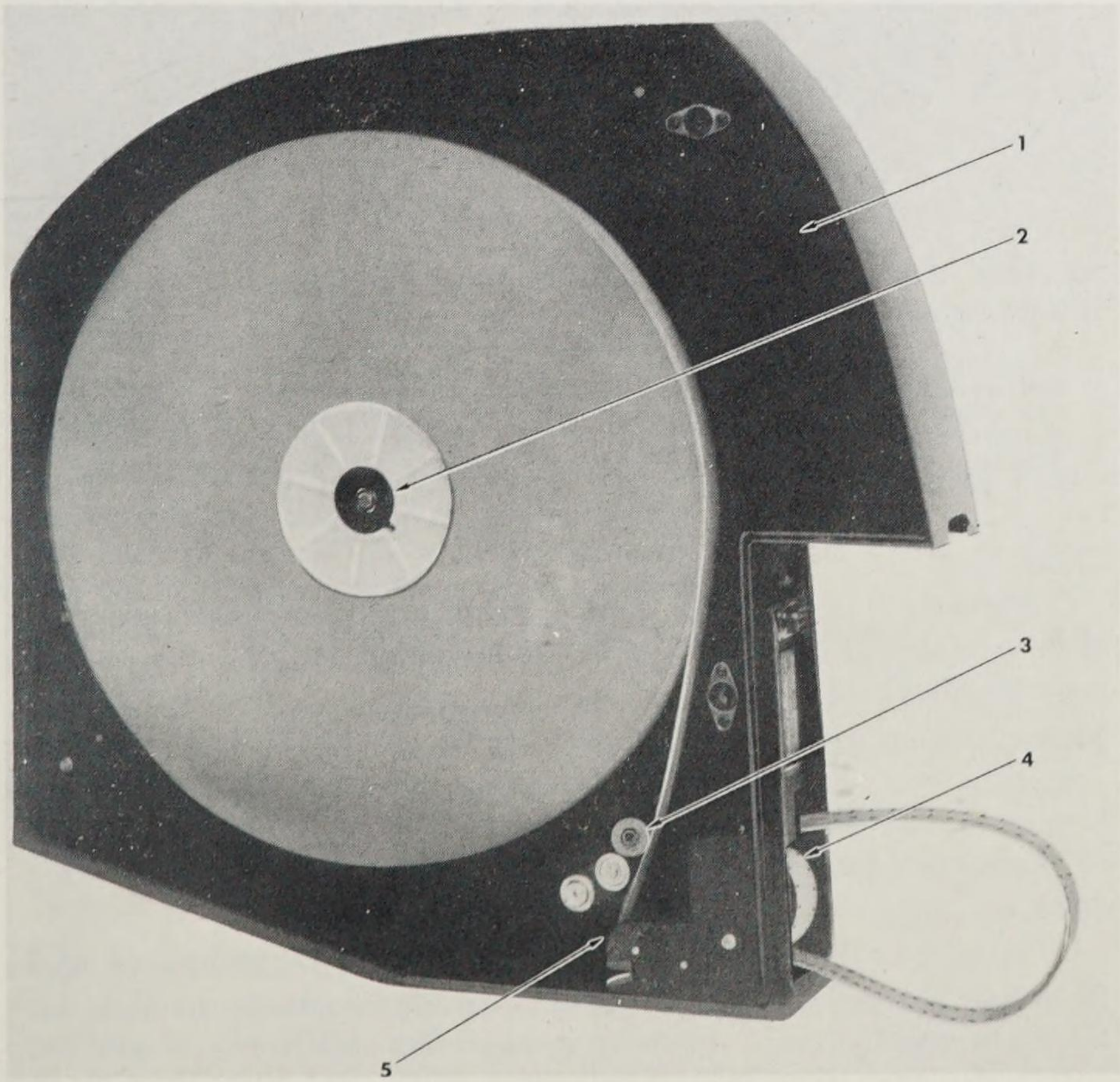


Fig. 12-8. Beckman & Whitley 1200-ft magazine (feed side). Courtesy of Beckman & Whitley, Inc.

1. Drive motor compartment
2. Lock tab
3. Guide roller
4. Transfer rollers
5. Light trap

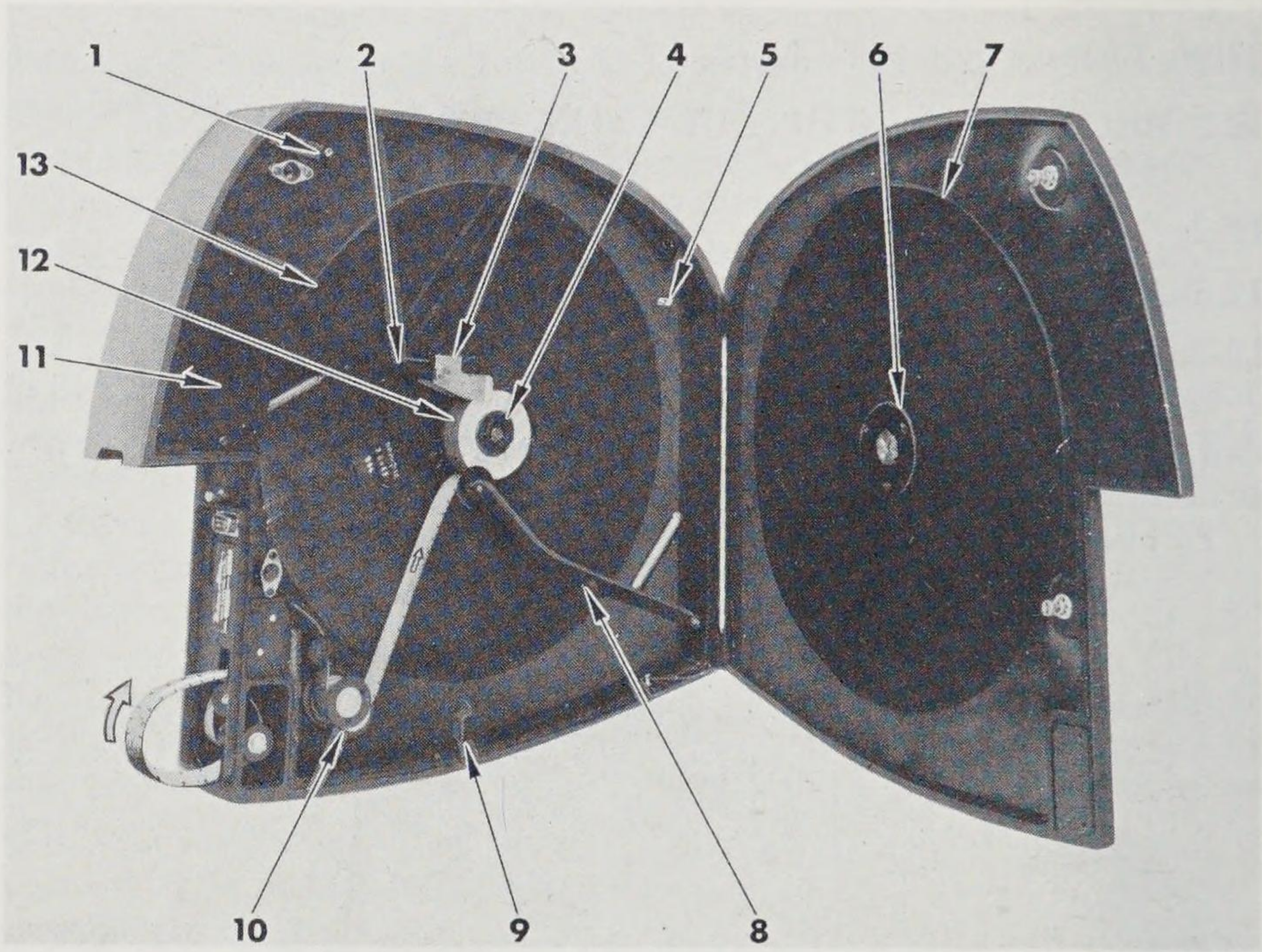


Fig. 12-9. Beckman & Whitley 1200-ft magazine (take-up side). Courtesy of Beckman & Whitley, Inc.

1. Film-guide storage post
2. Film-drive arm
3. Film guide
4. Adapter lock tab
5. Adapter storage post
6. Film tensioner
7. Film-guide pad
8. Reel guide arm
9. Spring latch
10. Sprocket footage-counter roller
11. Motor drive compartment
12. Take-up core
13. Heater

12.3d Feed

Right half. (Drive-motor compartment at top and transfer rollers at bottom should be at the loader's right.) Film (wound emulsion in) pulls off spindle clockwise.

12.3e Take-up

Left half. (Drive-motor compartment at top and transfer rollers at bottom should be at loader's left.) Film winds on spindle counterclockwise, emulsion *in*.

12.3f Loading

1. (Fig. 12-8) Rotate feed-lid key lock counterclockwise to open. 2. Rotate circular lock tab on spindle counterclockwise to clear lock tab from spindle. 3. In darkness, remove film roll from can and bag. Insert film end to right of feed guide roller and then through the light-trap roller. Push through 8–10 in. of film. *4*. Place roll on feed spindle so that core engages the ball-type spindle-pin springs and roll is flush with top of spindle. Then rotate the lock tab clockwise to secure core to spindle.

WARNING: Camera *will* run without the lock tabs secured; however, the core can "walk off" the spindle and cause a camera jam.

CAUTION: When loading single-perforated (B-wind) film, perforations must be inward (away from door) on the feed side; outward (toward door) on take-up side (see Fig. 12-6).

5. Close feed-side lid and secure by rotating both lid locks from "O" to "C." Check the locks by attempting to lift lid with fingernails. 6. In light, flip magazine over and open take-up lid by rotating the two lid locks from "C" to "O." 7. Push reel guide arm down and engage it in spring latch. Lift drive arm up and engage it in arm latch. Rotate take-up spindle lock tab counterclockwise to clear lock tab from spindle. 8. (Fig. 12-6) Form a loop on the 8–10 in. of film and fit loop: (a) Over top of the 45° transfer roller (edge of film should just touch edge-guide post). (b) Under the lower transfer roller. 9. (Fig. 12-9) Loop film once more and insert end into take-up light trap above the transfer rollers. 10. Place film to right of idler roller and under sprocketed footage-counter roller. Make certain film perforations engage sprocket teeth! 11. Insert film into core slot. Place core on spindle locating pin and wind up on spindle counterclockwise.

CAUTION: It is important to align film edge with core to ensure even take-up on the core.

12. Rotate spindle lock tab clockwise to secure core to spindle.

WARNING: Camera *will* run without lock tab secured. However, core can "walk off" spindle and cause a camera jam.

13. Release film-arm catch (push forward). Lower the film-drive arm onto top of core. Raise reel-guide arm *up* to bottom of core. 14. Depress latch at base of lid and close take-up lid. Secure by turning lid locks counterclockwise. Remove slack in take-up by depressing and rotating film tensioner in lid (see Fig. 12-1) counterclockwise. Zero the footage counter.

To load daylight spools: Remove film guide from take-up film-drive arm and place on film-guide storage post at top front of magazine interior. Raise and lock film-drive arm in arm latch. Lower reel-guide arm and engage it in spring latch.

NOTE: The 1200-ft magazine accepts daylight spools on the take-up side *only*.

12.3g Unloading

In darkness, remove take-up lid. Rotate spindle lock tab counterclockwise to clear lock tab from spindle. Place index finger on core and thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

12.3h Footage counter

Subtractive. Sets to 1200 ft by rotating counter reset knob located at the lower right side of the feed lid. Indicates remaining footage.

CHAPTER 13

Eclair Cameras, Magazines, and Blimp

13.1 ECLAIR 35mm CAMEFLEX CAMERAS* (Figs. 13-1, 13-2)

NOTE: All directions are from the Operator's point of view.

13.1a Base

Base includes camera body and turret. Attached to the bottom is a flat male dovetail (Fig. 13-1) fitted with a ⅜"-16 and/or ¼"-20 tapped hole to accommodate tripod lockdown screw. Otherwise, the wedge-shaped dovetail is inserted into a female adapter on an Eclair tripod.

To mount on Eclair tripod: Slide camera dovetail into female adapter until lock pin snaps into hole in bottom of dovetail.

To remove from tripod: Lift pressure cam at front of female adapter; pull lock pin down; remove camera from female adapter.

13.1b Motors

To mount: Tilt motor base 45° toward the rear. Insert motor-drive dog into female fitting. Tilt forward. Secure by tightening spring-loaded motor-locking screw. Rotate magazine drive gear (at right of pulldown claw—see Fig. 13-2) to check engagement of motor.

Variable-speed–motor regulator: Squeeze pressure catch (at top front of motor) to disengage it from the rheostat. Turn motor rheostat (clockwise to increase speed, counterclockwise to decrease speed) and check fps speed on tachometer. Re-engage pressure catch to hold motor at desired speed.

NOTE: A minimum of 8 volts is required to run the camera with a 400-ft load.

The following motors are available for the Eclair 35mm Cameflex:

Variable-speed motor: 6/8V DC; 24V DC.

Governor-controlled (constant-speed) motor: 12V DC (24 fps); 12V DC (25 fps).

Synchronous motor: 110V AC 60 Hz (24 fps) single phase; 110V AC 50 Hz (25 fps) single phase; 220V AC 60 Hz (24 fps) single and 3-phase; 220V AC 50 Hz (25 fps) single and 3-phase.

Animation/stop motion motor: 24V DC (with magnetic brake).

13.1c Power line

Square two-pin Eclair biplug (one male, one female contact) is inserted into base of motor. Rotating the screw at the bottom of the plug will spread the slotted male pin and lock the plug to the motor.

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*In the United States, the Cameflex is also known as the Camerette and the CM3.

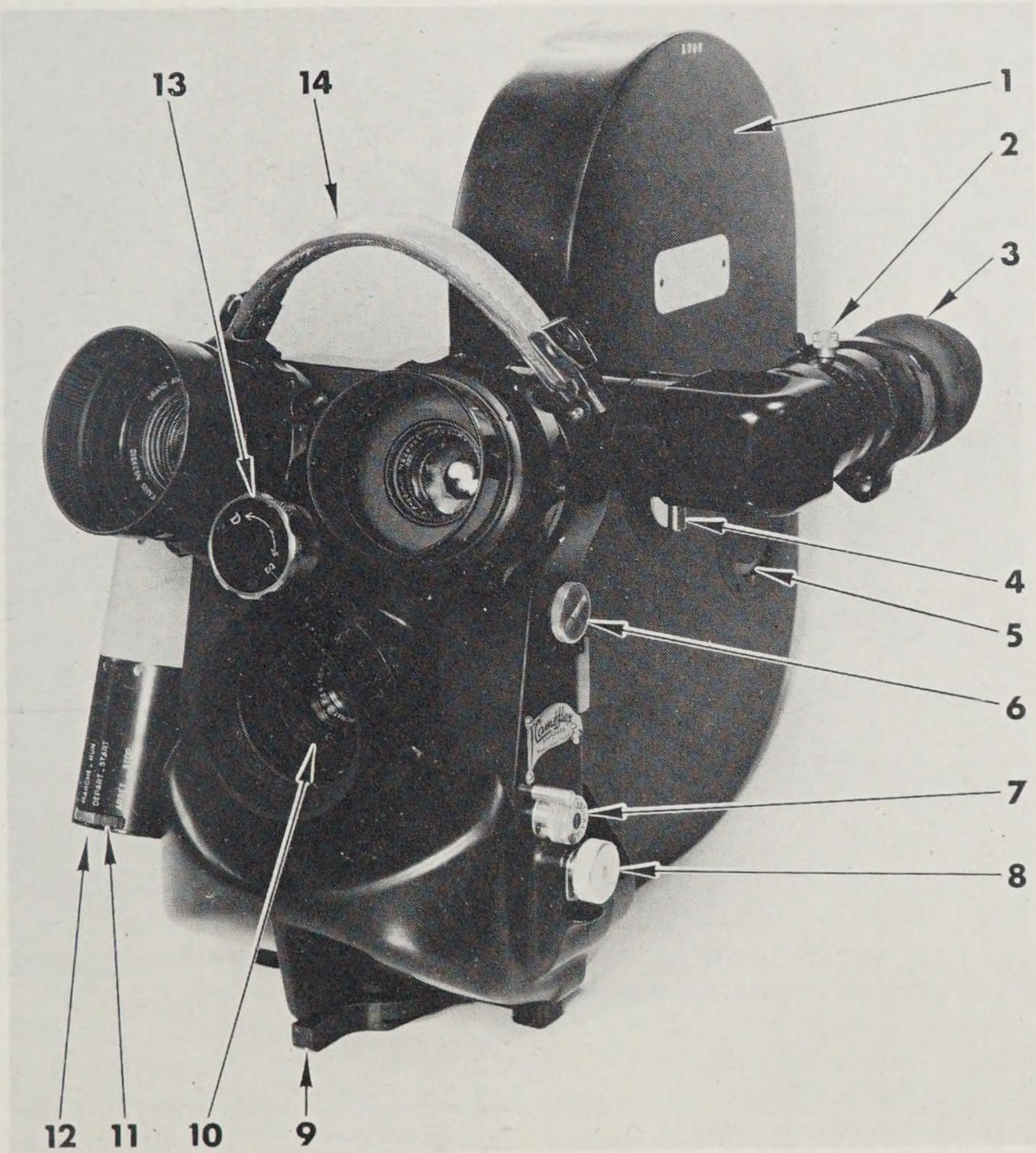

Fig. 13-1. Eclair Cameflex Standard (without matte box). Courtesy of Eclair International Diffusion

1. Magazine
2. Dioptrics lock
3. Eyepiece
4. Magazine lock bar
5. Magazine footage counter
6. Goundglass-cleaning plug
7. Shutter setting knob
8. Inching knob
9. Male dovetail
10. Taking lens
11. ON/OFF switch
12. Power plug (not visible)
13. Turret lock
14. Carrying handle

CAUTION: Be sure that power switch is off ("ARRET") before plugging in power line.

ON/OFF switch: Three-position switch is in base of motor (see Fig. 13-1). Positions are: (1) ARRET (stop); (2) DEPART (start); and (3) MARCHE (run). DEPART (start) is an interim position used

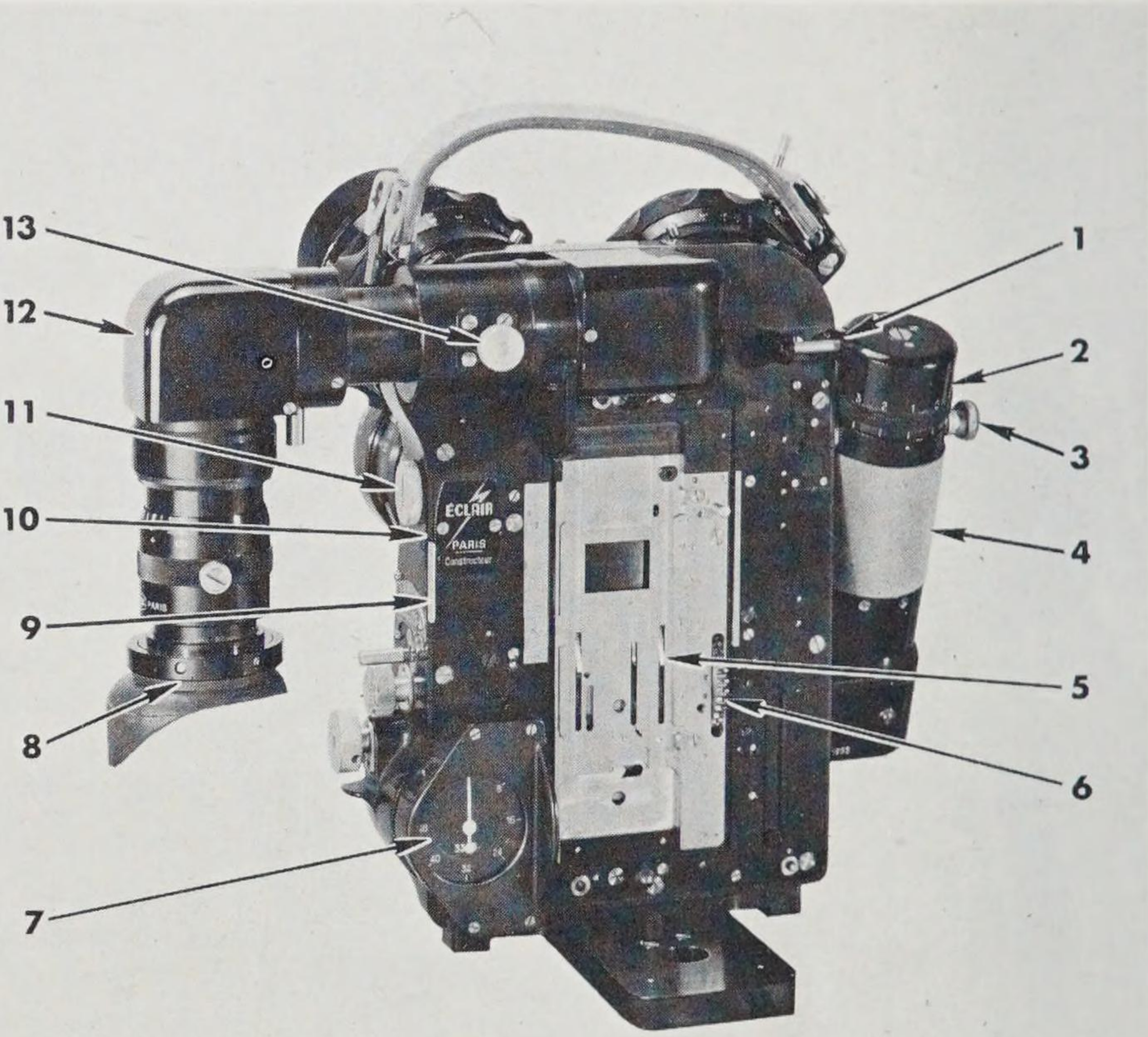

Fig. 13-2. Eclair 16/35mm Cameflex (rear view, without magazine). Courtesy of Eclair International Diffusion.

1. Protector-unit bracket
2. Motor rheostat regulator
3. Motor-locking screw
4. Variable-speed motor
5. 16/35mm pulldown claws
6. Magazine drive gear
7. Tachometer
8. Eyepiece latch
9. Filter-holder
10. Filter-holder safety catch
11. Groundglass cleaning plug
12. Prism housing
13. Eyepiece lockdown screw

to bring the motor up to speed only, and then the switch is to be moved immediately to MARCHE (run) for normal filming.

CAUTION: Never leave the switch in the DEPART position. This position is for turning the power on only.

13.1d Turret

Three-position; 21° divergence. The lowest port is the taking lens (see Fig. 13-1).

To rotate: Turn the central turret lock knob clockwise toward "D" (desserer: unlock). Pull knob outward and swivel the turret counterclockwise until desired lens is in taking position. Push turret in until seated.

To secure: Turn lock knob counterclockwise to "S" (serrer: lock).

13.1e Lenses

To mount: Insert bayonet base of lens into turret port and turn counterclockwise until secure.

To remove: Grasp milled ring on lens, turn clockwise, and withdraw lens slowly.

NOTE: Lenses used in the blimp must be fitted with geared rings in order to mesh with the blimp external controls. (See Secs. 13.6b and d).

13.1f Viewfinder: Reflex. Image magnified 6-1/2 ×.

To align reflex mirror for viewing: Depress and rotate counterclockwise, the inching knob (Fig. 13-1) at lower left side of camera (marked "REFLEX").

To view through eyepiece: Press eye against eyecup to open automatic eyepiece-closure device.

Eyepiece: Moves in and out. Adjusts to achieve focus on groundglass. Dioptrics lock holds eyepiece at individual's focus.

To lock eyepiece open: Turn eyepiece latch clockwise around eyepiece plate. Rotate counterclockwise to close.

Groundglass (not shown): Installed above the aperture with the smooth side *up*. Nonremovable.

To clean smooth side: Remove groundglass-cleaning plug (the screw securing the gelatine-holder safety catch) (see Fig. 13-1) completely from the camera. Insert an Eclair groundglass cleaning brush through the tapped hole.

To clean grainy side: Remove taking lens and insert an Eclair groundglass cleaning brush through the lens port.

Right- or left-eye viewing: Loosen eyepiece lockdown screw (see Fig. 13-2) counterclockwise (at camera housing) one turn. Pull prism housing laterally in its restricted slot. To remove completely, rotate the screw counterclockwise all the way. Slide prism housing out of keyed slot.

To alter finder position for viewing: Rotate prism housing in desired direction (it will rotate 360°). Four-position "recess lock" halts finder in up, down, forward, back positions, but finder will stay at any in-between position.

13.1g Sunshade/matte box (not shown)

Bellows sunshade/matte box mounts on two rods that fit into the Eclair female adapter (not shown). To use the sunshade/matte box on any tripod other than an Eclair, the detachable female adapter must be taken off tripod and fitted to the male dovetail on camera. The unit is adjustable left and right, in and out.

Individual masks: Correspond to the focal length of lens in use; mask slides into front of sunshade.

To verify clearance: Sight through eyepiece and run forefinger around inner edge of mask. If tip of finger is visible, move entire unit toward lens. Repeat check until matte box is clear of lens.

13.1h Filters

Two 3 × 3 in. glass holders are housed in matte box. Rear holder revolves. A circular ring at the back measures 48mm for pola-screen.

Gelatine: Filter slot is located at camera left side. Holder is held in place by a safety catch. Bent portion of holder (used as a finger grip) should *always* face the operator.

CAUTION: Filter holder must *always* be inserted into camera to avoid fogging of film—whether or not gelatine filter is used.

NOTE: The manufacturer emphasizes extreme care and inspection of gelatine filters. Dirt or lint on the gelatine may register on the film when lens is stopped down. The manufacturer recommends filter be removed after each take and inspected.

To remove holder:

1. Loosen groundglass-cleaning plug and lift filter-holder safety catch. 2. Slide holder out.

13.1i Door: None.

13.1j Footage counter: None.

13.1k Magazines: 400-ft (shown); 200-ft, and 100-ft.

To mount:

1. Clean plate and gate. Pull film from face of magazine; set loops (see Sec. 13.3f). 2. Grasp front of camera with one hand. Slide magazine forward to meet the plate until it locks (use bottom of the eyepiece mounting and side of tachometer as guides). 3. Make certain that magazine catch (at top front of magazine) is *up* (locked). Gently try to move the magazine sideways to make sure it is properly secured.

To remove: Press magazine catch down, pull magazine back.

13.1l Tachometer

Located at left side of camera near the base (see Fig. 13-2). Registers 0–40 fps in increments of 8 frames per second.

13.1m Shutter: Variable; 35–200°.

To adjust:

1. Remove taking lens. Depress spring-loaded REFLEX (inching) knob and turn until leading edge of mirror reaches upper left-hand corner of aperture, i.e., edge closest to inching knob. 2. Loosen slotted shutter-plate locking screw (located below the aperture, not visible) inside the lens port. 3. Push in the spring-loaded knob marked OBTURATEUR (shutter) located above REFLEX (inching) knob (see Fig. 13-2). Turn clockwise until desired shutter setting appears on scale along edge of mirror. 4. Tighten shutter-plate locking screw and replace the lens.

WARNING: Check shutter setting often.

13.1n Lubrication (Fig. 13-3)

Manufacturer recommends frequent oiling of all moving parts with

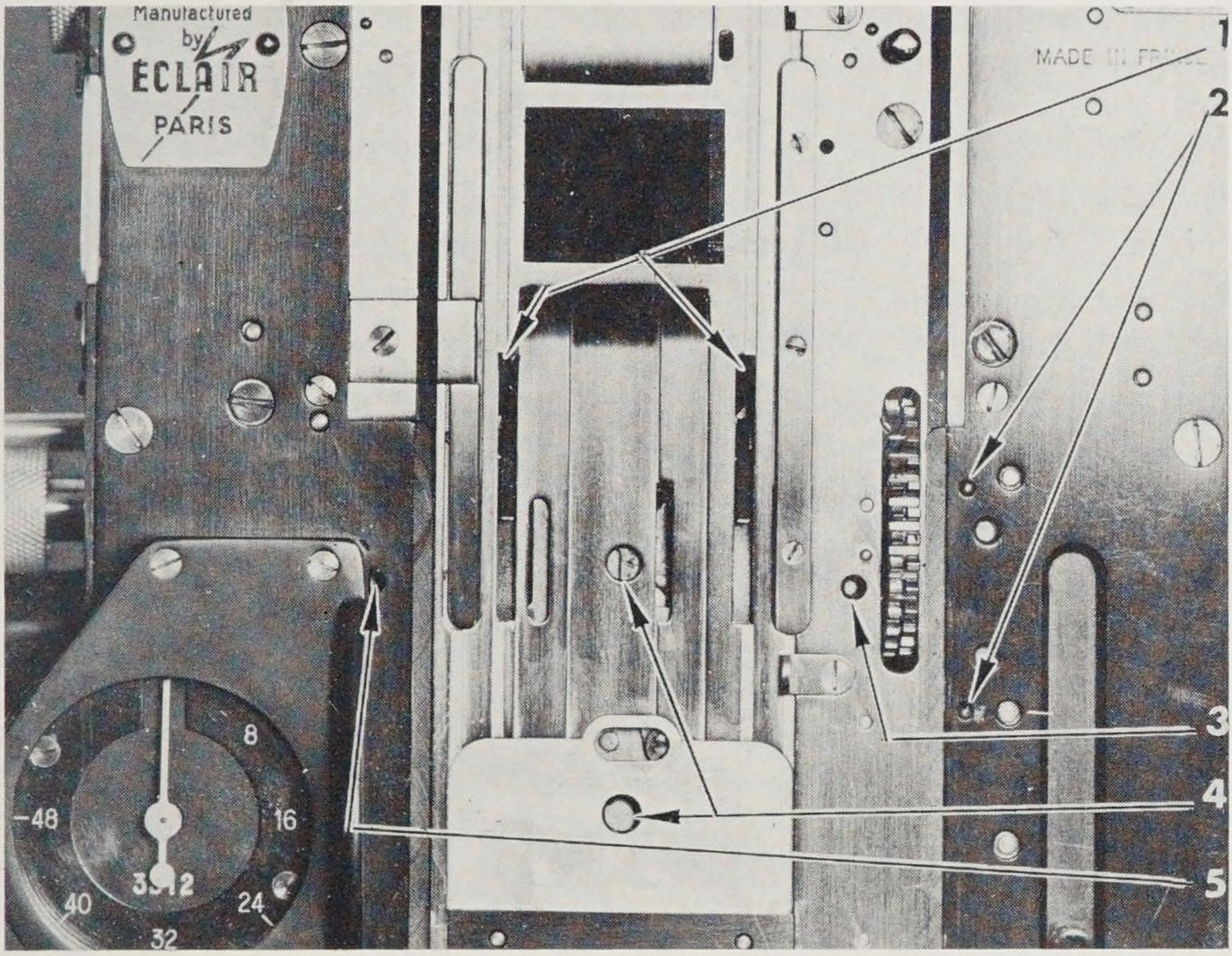

Fig. 13-3. Eclair Cameflex lubrication. Courtesy of Eclair International Diffusion.

1. 35mm pulldown-claw register slots
2. Shaft for accessory drive mechanism
3. Claw-slide guide
4. Claw-slide drive bearing
5. Claw-slide guide

a small quantity of oil. Oil holes are usually marked in red (older cameras may not have this color-coded feature).

Claw-slide guide: two holes (one at each side of plate).

Claw-slide drive bearing: two holes in plate.

Drive mechanism: depress antidust covers (ball bearings at right side of plate) with point of oil can.

13.1o Cleaning

Optics: Use soft camel's-hair brush or bulb syringe.

Use *only* a bulb syringe on the reflex mirror because the silver on the mirror is delicate and lifts easily.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove emulsion build-up with orangewood stick. 2. Wipe plates with chamois or soft cotton handkerchief (not linen). 3. Clean pull-down claws with soft brush. Avoid entering slot.

13.1p Weight: (with 400-ft load) 19 lb.

13.1q Troubleshooting

Trouble	*Probable Cause*
Camera does not start	Dead battery; power line faulty
Camera "hunts"	Motor cold; power terminals dirty; magazine threaded improperly
Camera stops while filming	Magazine jam—loops set improperly
Perforation tear; accordion pleat in film	Dirty pressure plate; loop uneven
Intermittent grind	Magazine not mounted properly

13.2 ECLAIR 16/35 CAMEFLEX CAMERA (Fig. 13-2)

The 16/35 Cameflex Camera is distinguished from the 35mm Standard Camera by its aperture plate. The 16/35 aperture plate has three pulldown claws—one for 16mm and two for 35mm. When 35mm film is running through the camera, the 16mm pulldown claw misses the 35mm emulsion by 0.005 in. The camera can be converted merely by inserting a 16mm *gate* into the 35mm aperture plate and using 16mm Cameflex magazines.

13.2a To convert 35mm to 16mm

1. Loosen groundglass-cleaning plug and lift filter-holder safety catch. 2. Remove gelatine-filter holder. 3. Insert 16mm gate into 35mm plate.

NOTE: The long *narrow arm* on the 16mm gate (not shown) fits to the *left* side when the gate is inserted into the 35mm plate. The short lateral pressure guide fits to the right. On older cameras, the *narrow arm* is the same length as the lateral pressure guide. The unit is inserted the same way as the long narrow arm type.

4. Insert the 16mm *gate holder* (not shown) into the gelatine-filter slot (this unit is similar in appearance to the gelatine-filter holder but is open at the end that is inserted into the camera). Secure safety catch on holder. Secure groundglass-cleaning plug. 5. Check to see that the 16mm gate is being held in place by the gate holder (pull gently on the 16mm gate).

CAUTION: The 16mm gate on any one camera is *not* interchangeable with gates of other cameras—each gate must be factory adjusted to the specific camera.

13.2b To convert from 16mm to 35mm: Reverse the above procedure.

WARNING: Be sure to insert the 35mm gelatine-filter holder into the camera to avoid fogging the film!

13.2c Protector unit (not shown)

Purpose of the unit is to store and protect the 16mm gate and gate holder so that the camera can be converted from 35mm to 16mm at

any time. A horizontal slot in the protector unit accepts the bent portion of the gate holder. The gate holder is stored within the protector unit in a vertical position with the gate below it. When the protector unit is inserted under the protector bracket at the top right of the camera and secured by a screw into a tapped hole at the base of the camera (see Fig. 13-2), the unit also acts as a right-side magazine guide.

13.3 ECLAIR 35mm CAMEFLEX MAGAZINE (Figs. 13-4, 13-5, 13-6)

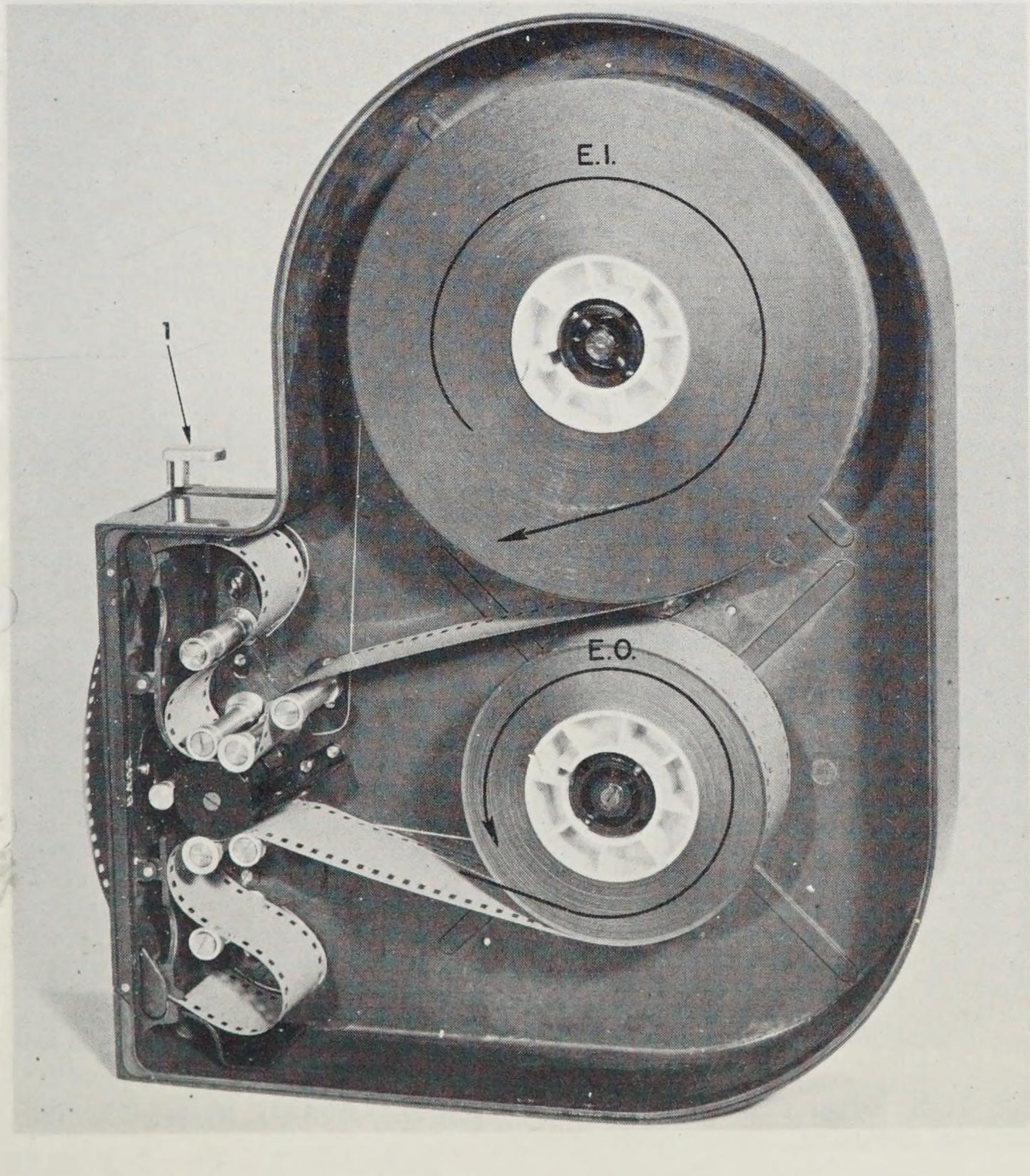

Fig. 13-4. Eclair Cameflex magazine (threaded emulsion in). Courtesy of Eclair International Diffusion.

1. Magazine catch

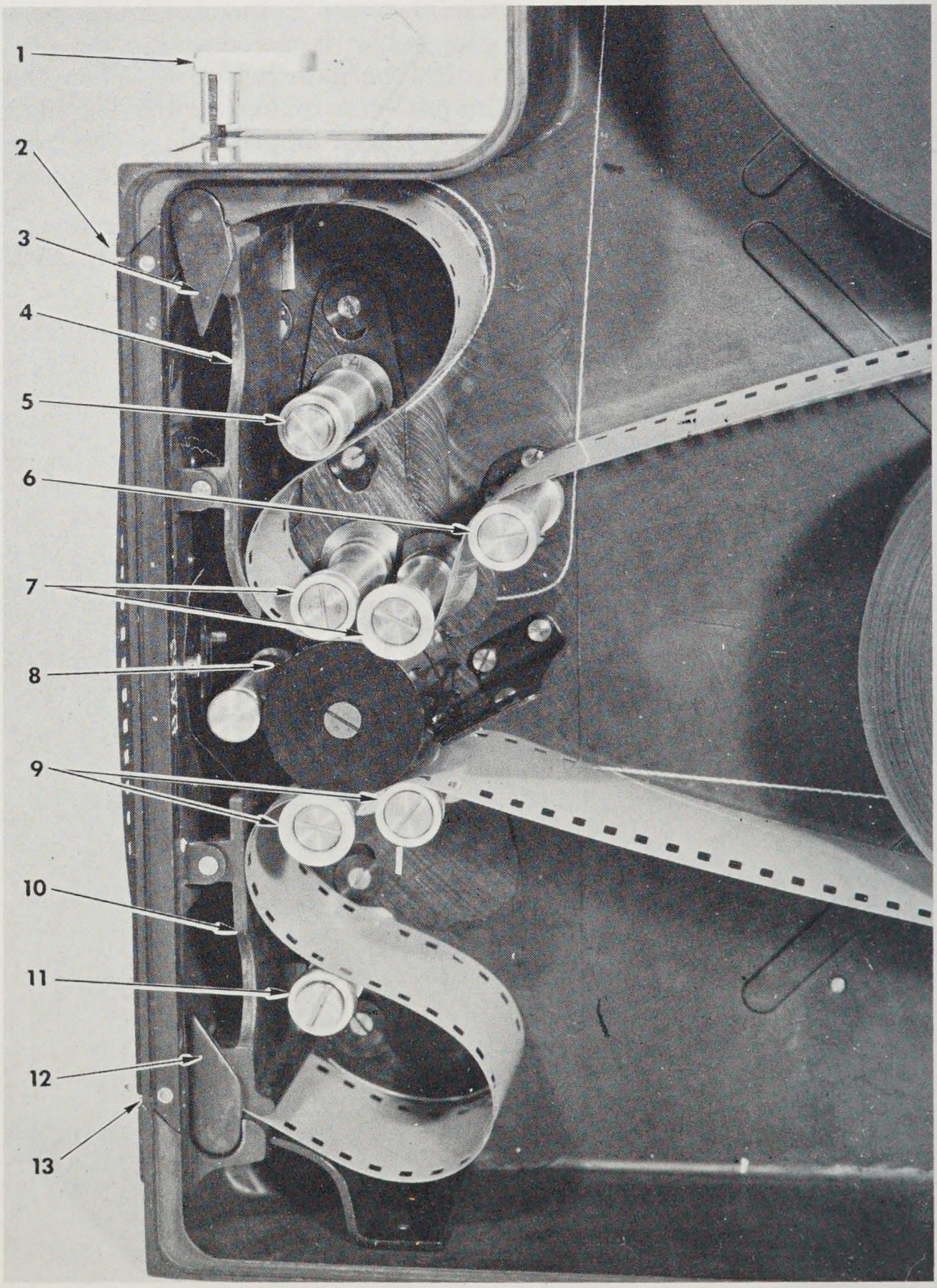

Fig. 13-5. Eclair Cameflex magazine (detail). Courtesy of Eclair International Diffusion.

1. Magazine catch
2. Upper curved slot
3. Upper side pressure plate
4. Upper light trap
5. Upper guide roller
6. Middle guide roller
7. Upper pressure rollers
8. Sprocket
9. Lower pressure rollers
10. Lower light trap
11. Lower guide roller
12. Lower side pressure plate
13. Lower curved slot

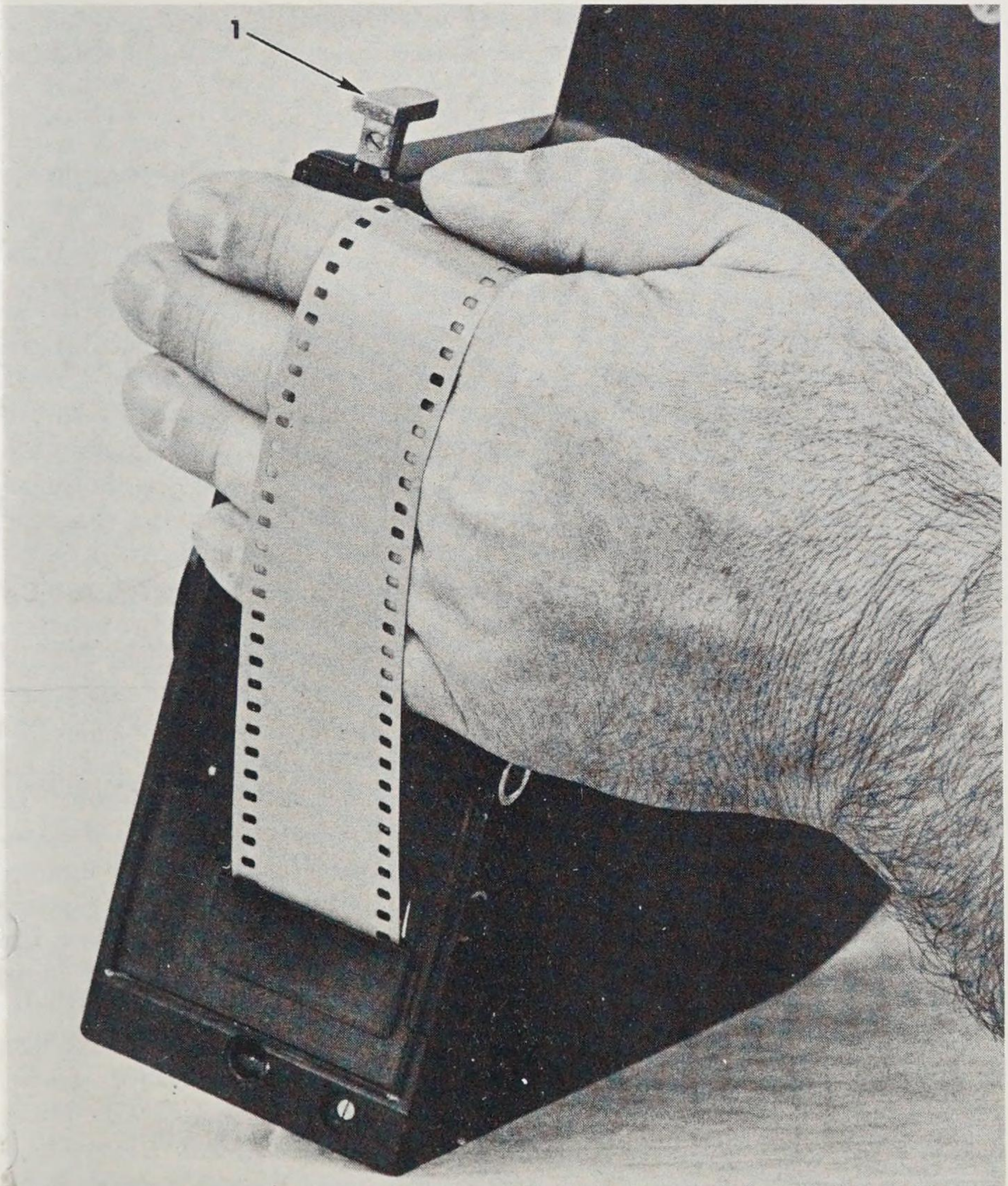

Fig. 13-6. Cameflex magazine, setting the loop. Courtesy of Eclair International Diffusion.

1. Magazine catch

13.3a Type: Displacement (over-and-under).

13.3b Capacity: 400-ft (shown).

13.3c Lid: One. Dog-locked.

To open: Rotate lock bar counterclockwise.

13.3d Feed

Top. Film (wound emulsion in) pulls off spindle clockwise. Film (wound emulsion out) pulls off spindle counterclockwise.

NOTE: Film (wound emulsion in) should be loaded as pictured. (The magazine interior is usually scribed with emulsion-out guide lines.)

13.3e Take-up

Bottom. Film winds on spindle counterclockwise, emulsion always out.

13.3f Loading (Fig. 13-5)

1. Remove magazine lid. 2. Pull, then slide, the upper guide roller toward top of magazine to free the upper pressure rollers from the sprocket. 3. Pull, then slide, the lower guide roller toward bottom of magazine to free the lower pressure rollers from the sprocket. 4. Lift *up* and rotate the spring-loaded upper side pressure plate counterclockwise and the lower side pressure plate clockwise. 5. In darkness, remove film roll from can and bag. Place roll of film onto the feed spindle and pull off clockwise. 6. Depress the upper light trap below the pivot pin, causing the shoe of the trap to move away from the pressure pads. Push film through the upper curved slot (approximately 2-1/2 ft). Release the upper light trap. 7. Place film *over* the middle guide roller, then *between* the upper pressure rollers and sprocket, then *back* (i.e., to the right) of the upper guide roller. 8. Push the upper guide roller down to engage the film between the upper pressure rollers and sprocket. 9. Depress the lower light trap above the pivot pin. Push film end through the lower curved slot. 10. *To prepare the proper size loop* (Fig. 13-6): (a) Place the left hand against the pressure pads and behind the film. (b) Slide the left hand along the pressure pads upwards to the top of the magazine just below the magazine catch, thus pulling up enough film for the internal loops which will be set later. 11. Holding film with the left hand, pull the surplus film into the magazine with the right hand. 12. Thread film in *back* (i.e., to the right) of the lower guide roller (see Fig. 13-5), then *between* the lower pressure rollers and sprocket. Push lower guide roller *up* to engage film. 13. Rotate and depress the spring-loaded side pressure plates (top and bottom). 14. Wind the excess film inside the magazine counterclockwise onto the take-up core. Pull taut by turning the lower spindle wheel clockwise. To remove slack from the feed roll, rotate the top spindle wheel clockwise. 15. Replace lid.

CAUTION: If lid does not fit easily, check the seating of the guide rollers, pressure rollers, and side pressure plates.

16. *To set loops:* In light, the film outside the magazine is pulled away from the pressure pads to form an arc extending from the upper curved slot to the lower curved slot. With the forefinger, press the center of the arc against magazine to form two equal halves, which, when individually pushed into the magazine, form the upper and lower internal loops.

NOTE: (a) It is recommended that loops always be reset just before fitting the magazine to the camera. (b) Most magazines have protective covers which snap over the pressure pads and film after being loaded. Covers are released from the magazine by depressing the magazine catch (See Figs. 13-4, 13-5, and 13-6). (c) Magazines are released from camera by depressing the magazine catch and pulling the magazine back.

13.3g Unloading

In darkness, remove lid. Place index finger on core, thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

13.3h Lubrication

Remove screws on the feed, take-up, and main sprocket spindles. Insert four drops of oil in each. Replace screws. Lubricate often.

13.3i Footage counter: In lid. Subtractive in increments of 10 ft.

13.4 ECLAIR 16mm CAMEFLEX MAGAZINE (not shown)

Feeds, loads, takes up, and unloads the same as the 35mm magazine (see Sec. 13.3). Feed and take-up spindles are removable to accommodate spools. Footage counter on lid is subtractive in increments of 10 ft. An additional counter on the back is additive up to 200 ft in increments of 10 ft.

13.5 ECLAIR 35mm MAGAZINE FOR AQUAFLEX (low silhouette) —(not shown)

This magazine is designed for use in low clearance areas (underwater blimp, airplane wing, auto interiors, etc.)

13.5a Type: Displacement

WARNING: Unlike the Standard magazines (over-and-under feed and take-up) the feed and take-up rolls are in *tandem*. The feed spindle is at the right side (farthest from the magazine pressure plates), the take-up spindle is at the left.

13.5b Capacity: 400-ft.

13.5c Lid: One. Dog-locked.

13.5d Feed

Right side. Film (wound emulsion in) pulls off spindle clockwise. Film (wound emulsion out) pulls off spindle counterclockwise.

13.5e Take-up

Left side. Film winds on spindle counterclockwise, emulsion always out.

13.5f Loading

Same as standard magazines (see Sec. 13.3) except for placement of the feed and take-up spindles (as noted above) and two additional rollers (see below).

NOTE: Two extra film-guide rollers, located at the top of the magazine, aid in the transport of the film from the feed (right) side *over* the take-up roll and down to the middle guide roller, where the magazine is threaded in the conventional manner and then wound onto the take-up (left) side.

13.5g Unloading: Same as the standard magazine.

13.5h Footage counter: In lid. Subtractive in increments of 10 ft.

13.6 ECLAIR CAMEFLEX BLIMP (Figs. 13-7, 13-8)

NOTE: All directions are from the Operator's point of view.

13.6a Base

Bottom of blimp may be fitted with a male dovetail adapter plate (see Fig. 3-8) which fits to an Eclair tripod/dolly.

NOTE: Removal of the blimp adapter plate reveals that the blimp bottom has two ⅜"-16 tapped holes to accommodate a standard tripod lockdown screw.

Adapter plate (see Fig. 13-8): Unit is secured to the blimp by ten screws. It is fitted with three ⅜"-16 tapped holes to accommodate a standard tripod lockdown screw.

Two sockets at rear of adapter plate have lock levers which accept an Eclair tripod handle. The flat bar between the two sockets is a release handle.

To mount blimp: Slide adapter plate at bottom of blimp into the female Eclair tripod plate until a loud click is heard, indicating the plate is locked.

To remove blimp: Pull flat-bar release handle (not shown) at rear of plate. Slide blimp back.

13.6b Camera preparation

Lenses: Remove two top lenses from turret. Place the lens port plugs into empty ports.

NOTE: When used in a blimp, camera requires CICCA lenses (the Eclair designation for mounts fitted with geared footage and aperture rings).

Inching knob: Slide 7/8-in. intermediate (extension) piece (see Fig. 13-9) over the camera inching knob. Secure jaw by rotating the milled nut. This extension will engage the arm rotated by the exterior inching knob when the camera is inserted into blimp.

Eyepiece: Remove from camera.

Eyepiece adapter: (Unit measures 1-3/8 in. long and contains a compensation lens.) Insert the long part of the barrel into the camera. The knurled ring acts as a shoulder stop. Unit is slotted to accept the lockdown screw in the eyepiece holder.

Magazine can be on the camera and threaded when inserted into blimp.

13.6c Access

To interior: Release catch at top of blimp. Right side of blimp is hinged, drops 90°.

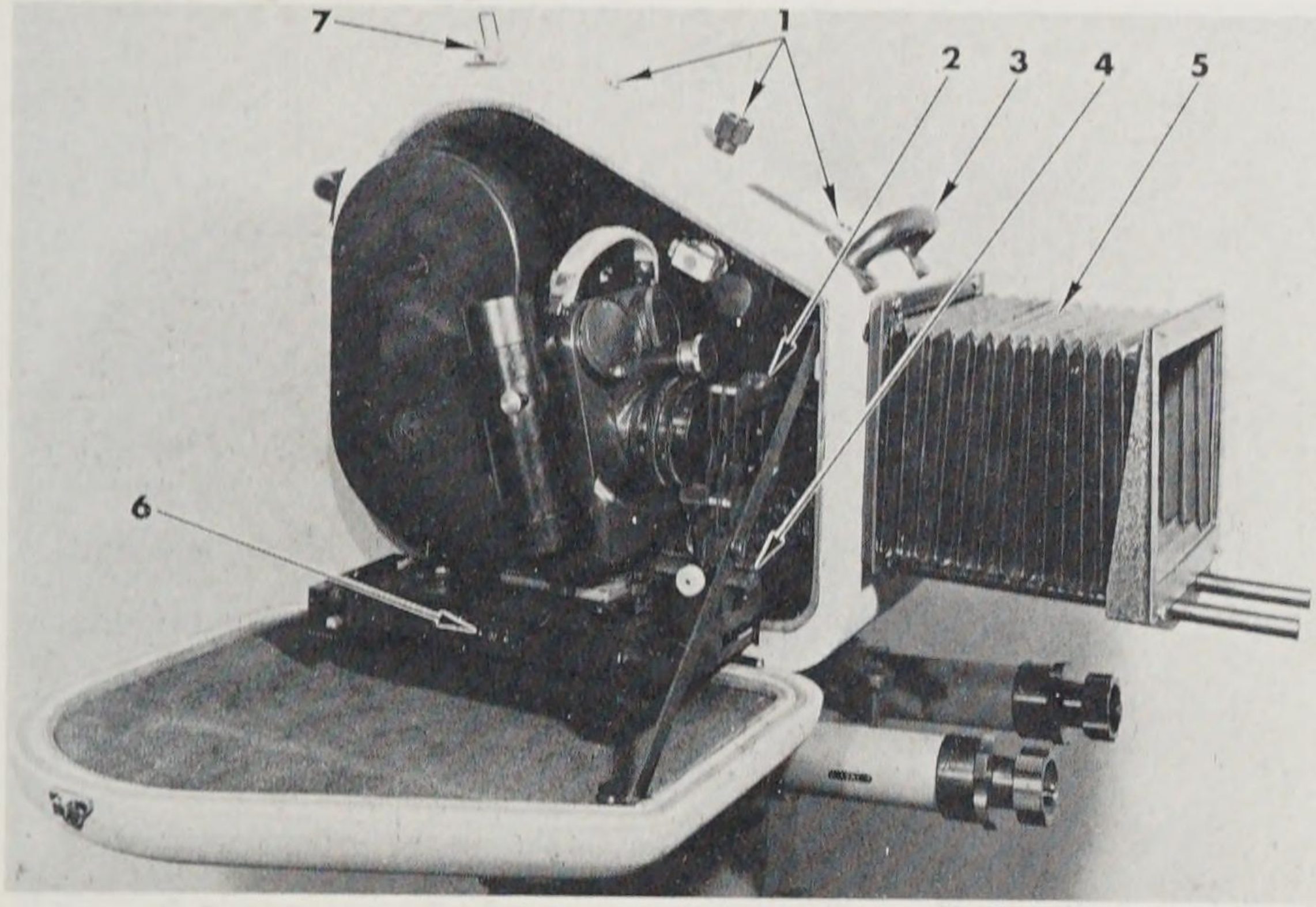

Fig. 13-7. Cameflex blimp (right side). Courtesy of Eclair International Diffusion.

1. Accessory units
2. Two-stage filter holder
3. Carrying handle
4. Filter-holder dovetail
5. Extended sunshade
6. Internal base plate
7. Access catch

13.6d Camera insertion (Fig. 13-9)

1. Release spring-loaded catches on internal base plate (push outward) and drop double-hinged rails 90°. Pull base from blimp interior along rails. 2. Pull knurled screw on spring-loaded camera lock at rear of base. 3. Unlock scalloped lens-gear lock at front of gear box. Push it away from the lens. 4. *Insert camera* into dovetail on base, making certain to slide the geared aperture ring on the lens into the aperture gear at the bottom front of the base. 5. Rotate and release the spring-loaded camera lock at the back of the base to secure the camera. 6. Push teeth of scalloped lens gear lock toward lens focus ring. Secure lens-gear lock. 7. Slide base into blimp; raise rails; close side of blimp.

13.6e Power line

External: Eight-pin Jaeger plug located at the left side below the inching knob.

ON/OFF switch: At left side. (MARCHE = on: down; ARRET = stop: up.) Red warning light glows when camera runs.

Internal: Extension from camera inserts into eight-pin Jaeger plug at right side of blimp interior.

13.6f Sunshade

To mount: Insert rods into sunshade (flanges out). Rotate tapped

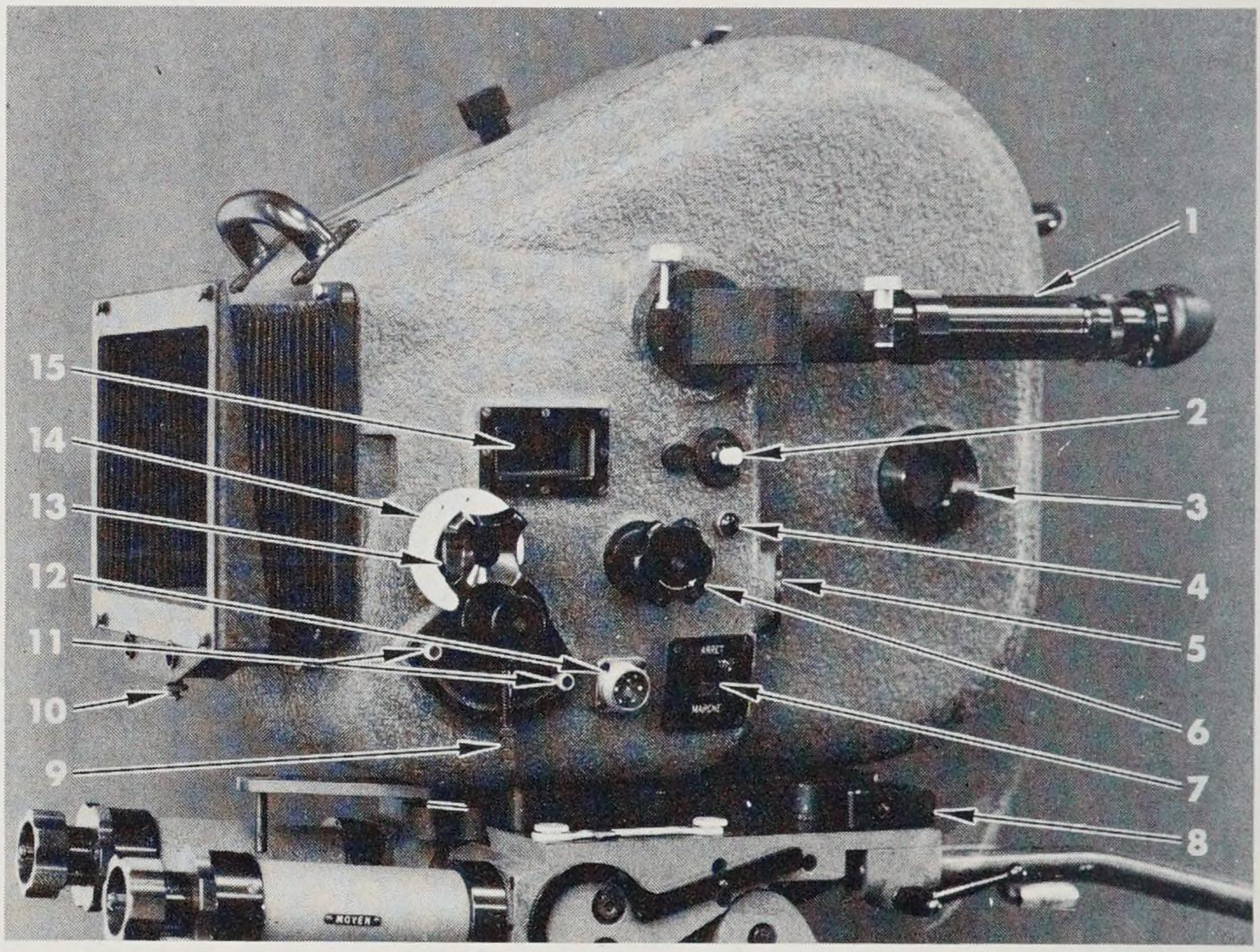

Fig. 13-8. Cameflex blimp (left side). Courtesy of Eclair International Diffusion.

1. Viewfinder
2. Internal light switch
3. Footage counter viewing port
4. Red warning light
5. Tachometer viewing port
6. Inching knob
7. ON/OFF switch
8. Adapter plate
9. Aperture-setting arm
10. Sunshade head screw
11. Aperture lock knobs
12. Power plug
13. Focus knob
14. Marking disc
15. Lens viewing port

rods into screws below front lens glass. Insert top of bellows over retaining screws. Align slots on bottom of sunshade over retaining screws. Slide rear of sunshade down. Move sunshade in and out by releasing knurled head screw (below rods).

NOTE: Rods are in three sections; they can be shortened if the wide-angle lens picks up ("sees") ends of rods.

13.6g External controls: At left side of blimp.

Internal-light switch: Exterior pushbutton at left side. (Dry cell for power inserts inside housing near the internal eight-pin plug.)

Inching knob: Rotates counterclockwise. Engages intermediate piece attached to camera (see Sec. 13.6b, Fig. 13-9).

Focus knob: Rotates either direction. Engages drive gear in base. Set lens at infinity and mark removable plastic marking discs with infinity (∞) and other footage marks. Removable marking discs can be made for each lens in use.

1. Set each lens to infinity. 2. Align infinity mark on corresponding disc to the footage indicator pointer.

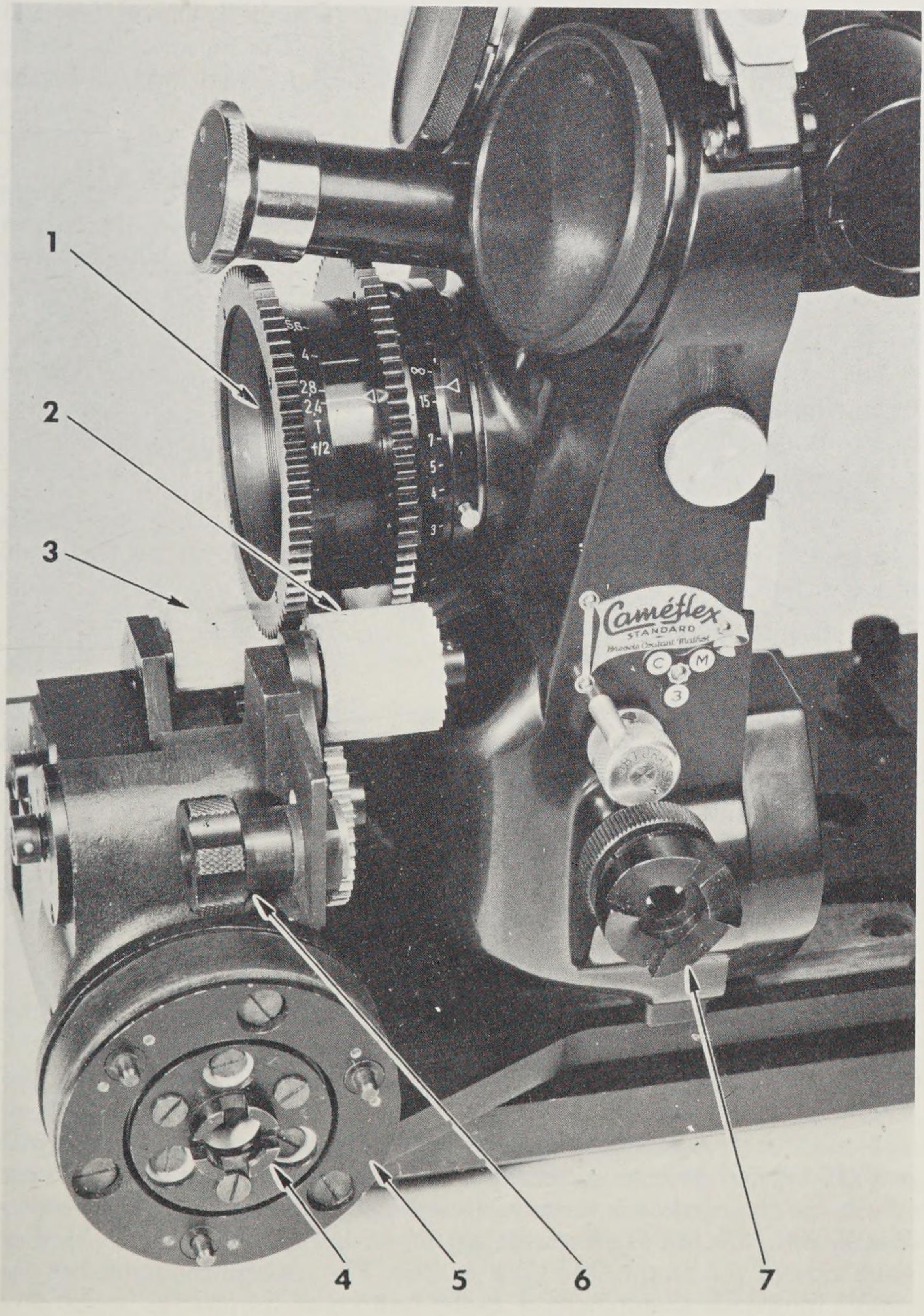

Fig. 13-9. Eclair Cameflex blimp (coupling detail). Courtesy of Eclair International Diffusion.

1. CICCA lens
2. Focus gear
3. Aperture gear
4. Aperture coupling
5. Focus coupling
6. Lens-gear lock
7. Inching knob intermediate

Aperture: Unlock aperture setting arm (which is locked by two small knurled knobs in a restricted slot) below the focus knob. Move lever forward or back to set lens diaphragm. Lock two knurled knobs to maintain desired aperture.

13.6h Ports

Left-front window above focus knob permits the viewing of footage and aperture settings on lens. Left-rear window at back allows the viewing of magazine footage counter. Window below eyepiece allows the viewing of the tachometer.

13.6i Filters

Two-stage filter-holder bracket slides into the dovetail located at the right side of the internal base, and locks with a knurled nut. Two 3 × 3 in. glass filters are inserted into the holder from the top.

13.6j Viewfinder

Reflex. Eyepiece adjusts as camera eyepiece. Dioptrics lock holds eyepiece at individual's focus. It adjusts to achieve focus on the grain of the groundglass.

13.6k Cams: None.

13.6l Camera removal

Open blimp side. Drop double-hinged rails, pull internal base plate from blimp along rails. Pull camera lock at back of base. Push the knob in the restricted slot at the right front of the base forward. Push camera back and out of dovetail.

13.6m Blimp top

Scalloped knob and two tapped holes at top of blimp are for accessory light units.

13.6n Weight: (less camera) 110 lb.

13.7 ECLAIR NPR 16 CAMERA* (Figs. 13-10, 13-11)

NOTE: All directions are from the Operator's point of view.

13.7a Base

None. An *angled cradle* (not shown) with a flat bottom fitted with a ⅜"-16 tapped hole to accommodate a tripod lockdown screw is used whenever the camera is to be mounted on a tripod. The camera motor inserts into the felt-lined cradle up to its hubs, which are located at each side of the motor ON/OFF switch. The camera is secured to the cradle by a lock screw located at the bottom of the cradle.

13.7b Motors

To mount: Insert motor drive shaft into female receptacle located at bottom of camera body. Swing lock blades inward to secure motor.

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*Manufacturer states the designation "NPR" stands for Noiseless Portable Reflex.

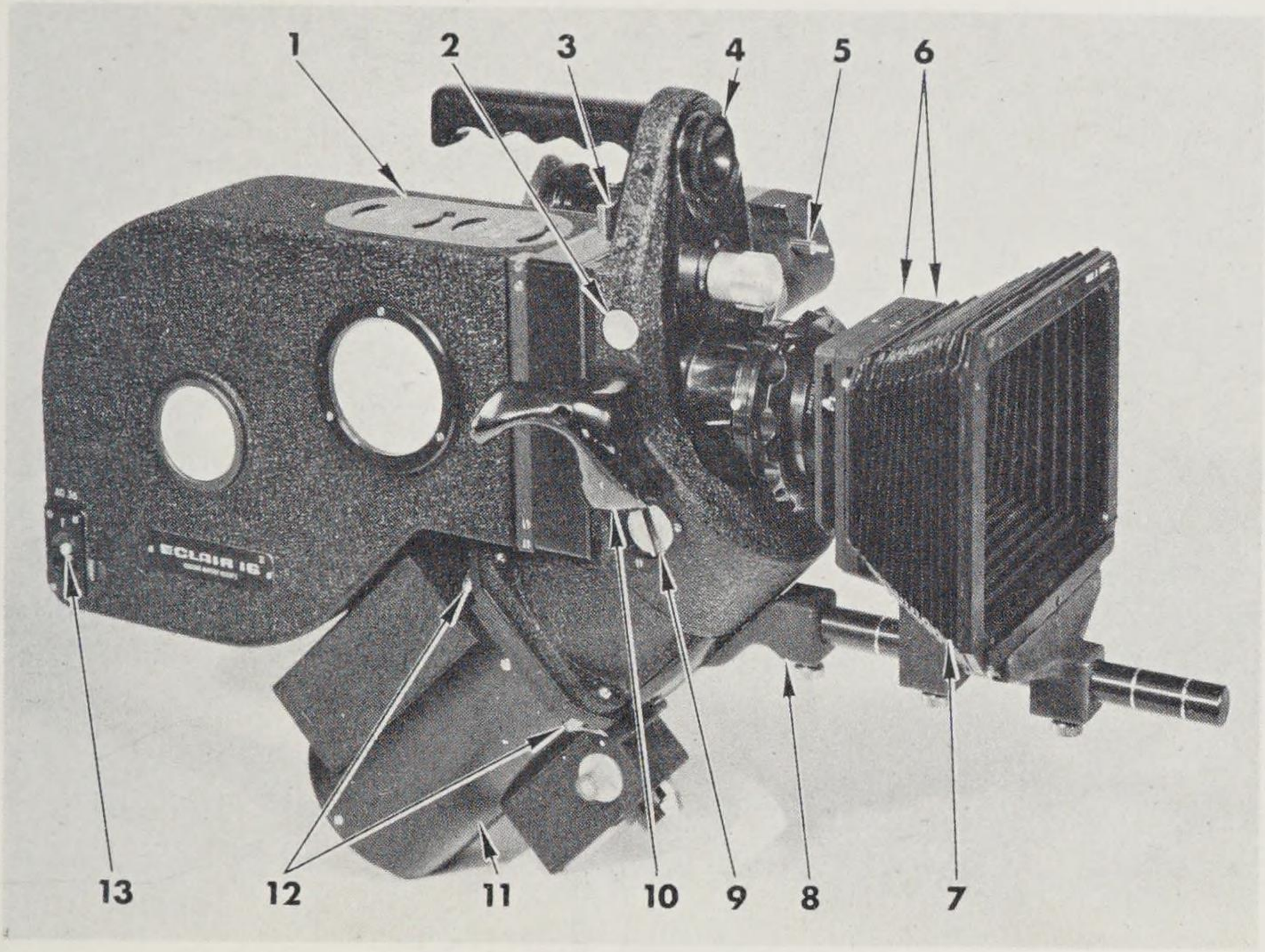


Fig. 13-10. Eclair NPR with standard lens and matte box (right side). Courtesy of Eclair International Diffusion.

1. Magazine footage counters
2. Magazine-lock button
3. Magazine-locking cam
4. Turret
5. Viewfinder position-lock
6. Matte-box filter holders
7. Sunshade
8. Matte-box rod socket
9. Variable shutter control
10. Thumbgrip (optional accessory)
11. Governor-controlled (constant-speed) motor
12. Motor lock blades
13. Magazine lid lock

To remove: Hold hand under motor. Swing four lock blades away from motor. Motor will drop free.

Governor-controlled (constant-speed) motor (shown): Pilot light at top left side indicates motor running at 24 fps when lit. There is *no* inching knob on the motor.

Variable-speed motor (not shown): Has a built-in electronic tachometer. Tachometer registers 0–40 fps in increments of five frames per second. A high-speed/low-speed selector switch is located at the left side of the motor. For 0–25 fps, set selector for low; for 20–40 fps, set selector for high.

A speed-control knob is located below the high/low switch. Rotate clockwise for fast, counterclockwise for slow.

No reverse; *no* inching knob on the motor.

NOTE: A minimum of 12V DC is required to run the camera with a 400-ft load.

CAUTION: Application of more than 14V DC or any AC will damage the motor.

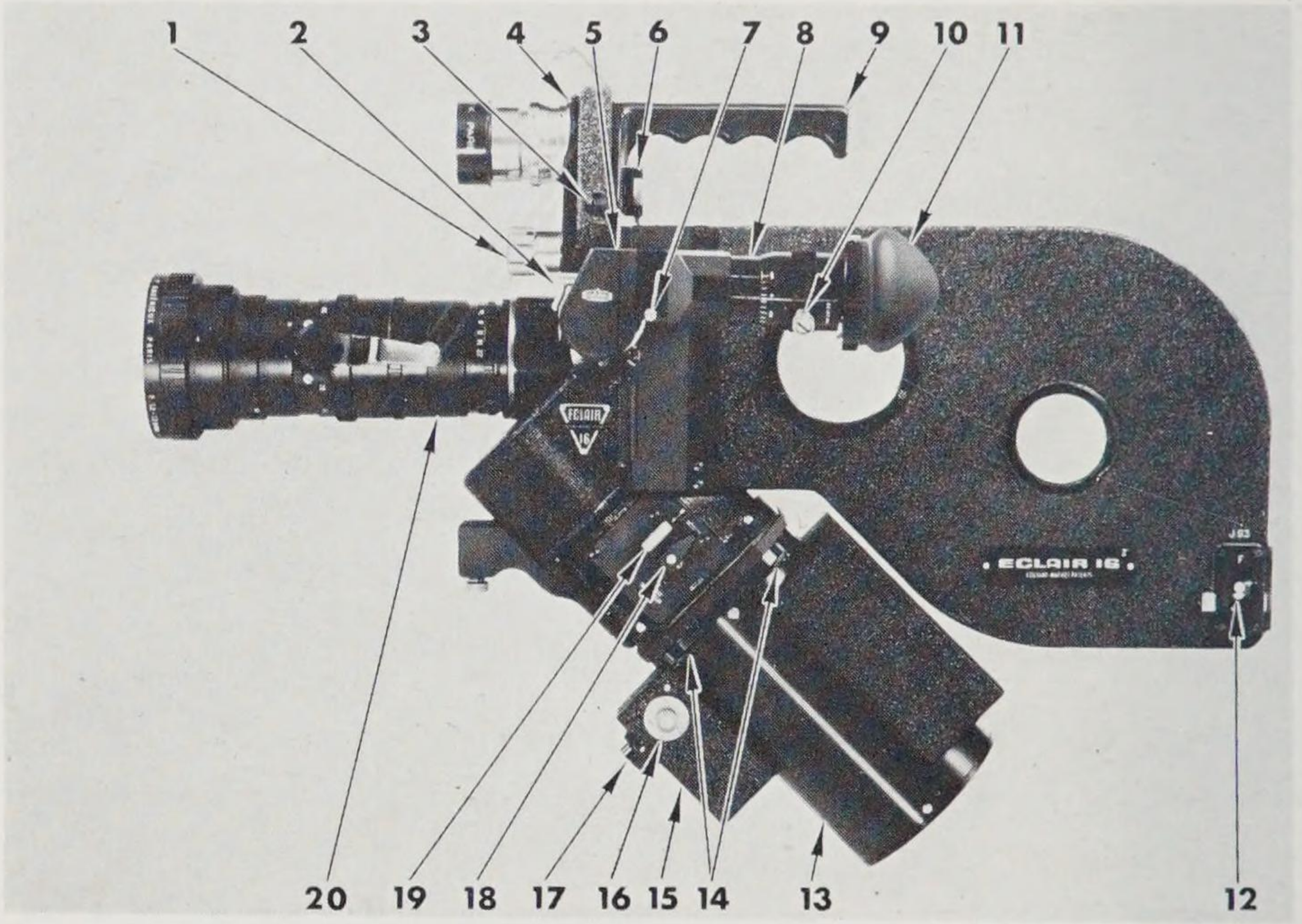


Fig. 13-11. Eclair NPR with varifocal lens (left side). Courtesy of Eclair International Diffusion.

1. Turret lock knob
2. Viewfinder-position lock
3. Automatic clapper
4. Auxiliary lens mount
5. Prism box
6. Magazine-locking cam
7. Eyepiece locking screw
8. Viewfinder
9. Carrying handle
10. Dioptrics lock
11. Eyecup
12. Magazine-lid lock
13. Governor-controlled (constant-speed) motor
14. Motor-lock blades
15. Power-line receptacle
16. Cradle hub
17. ON/OFF switch
18. Shutter-control lever
19. Inching knob
20. Taking-lens position

The following motors are available for the Eclair NPR:

Variable-speed motor: 8/12V DC (set at 8V: 0–25 fps; set at 12V: 20–40 fps).

Governor-controlled (constant-speed) motor: 12V DC (24 fps); 12V DC (25 fps).

Synchronous motor: 120V AC 60 Hz (24 fps); 120V AC 50 Hz (25 fps); 220V AC 60 Hz (24 fps); 220V AC 50 Hz (25 fps).

Crystal-controlled motor: (for cordless double system sound recording): 12V DC (60 Hz signal to tape recorder); 12V DC (50 Hz signal to tape recorder).

NOTE: The 12V DC crystal-controlled motor can be utilized as follows: 1. Cord type sync operation (cable from camera to recorder). 2. Cordless type sync operation (crystal generated reference frequency to camera and recorder). 3. Mains Reference Sync (camera motor follows the *frequency* of the local house power, the "mains," via an

intermediate transformer). (The motor is *not* powered by the house voltage.) 4. Playback (camera motor will follow frequency of a pre-recorded sync pulse on the tape). 5. Multiple camera sync operation (more than one camera in sync with only one recorder in use). 6. With an additional accessory attached, it becomes an 8–40 fps variable-speed motor.

13.7c Power line

Input to camera (see Fig. 13-11) inserts into a four-pin receptacle below the ON/OFF button at the front of motor: pin no. 1, ground (minus); pins no. 2 and 3, synchronous pulse; pin no. 4, plus.

Lock holds ON/OFF button down. To release, push up on lock.

13.7d Turret: Two-position. The lowest lens port is the taking lens.

To rotate: Turn central turret lock knob toward "D" (desserer: unlock). Pull outward and swivel turret 180°. Push in until seated. Turn lock knob toward "S" (serrer: lock) to secure. Pull knob to check seating.

13.7e Lenses

To mount: Insert bayonet base of lens into taking-lens port, with the split flange of the bayonet facing the turret lock (*up*). Turn in port until secure.

CAUTION: Snug lens only!

13.7f Viewfinder

Reflex. Image magnified 10×. Views more than full aperture. Area within scribe denotes full aperture. Some models may have a TV scribe (pumpkin) within the aperture.

To view through lens: Press eye against eyecup to open diaphragm.

To lock eyecup diaphragm open: Press firmly on eyecup.

To close eyecup diaphragm: Push eyecup to side.

To align reflex mirror for viewing: Turn shutter-control lever (at left side of camera housing) to "REFLEX," (Fig. 13-11) then rotate milled inching knob (forward of the lever) until the shutter clears the eyepiece. Return the lever to "MOTEUR" (motor).

To alter finder position for viewing: Loosen viewfinder-position lock (the lever at the left of the knurled coupling ring). Rotate eyepiece parallel to the camera in desired direction (eyepiece will rotate 360° and lock in any position).

To swivel eyepiece at right angles to the camera: (To set it for the left or right eye) loosen eyepiece-locking screw on left behind the prism box (Fig. 13-10).

To focus: Remove the taking lens, or unlock turret and set it in a horizontal position. Loosen dioptrics lock. Focus on scribe of ground-glass aperture.

To detach eyepiece: Loosen viewfinder coupling (knurled nut next to camera body). Pull eyepiece out of housing.

Groundglass: Located inside the camera housing above the aperture. Nonremovable.

13.7g Sunshade/matte box (see Fig. 13-10)

Bellows/sunshade slides on a single rod (Fig. 13-10) which inserts into a socket below the taking lens. On some models, a cradle mounted on a rod, which is inserted into the socket, supports a zoom lens when the sunshade is not used.

13.7h Filters

Double holder in matte box houses two 2 × 2 in. glass holders (Fig. 13-10). The rear holder rotates.

No filter slot for gelatines in the camera body.

13.7i Door: None.

13.7j Footage counter: None.

13.7k Magazine: 400-ft.

To mount:

1. Check condition of rectangular sponge rubber on face of magazine which fits against the camera plate and provides lighttight security. If intact, pull film from the face of the magazine and set the loops (see Sec. 13.8f and Fig. 13-14). 2. Set lower front of magazine into notches at the bottom of the gate plate. Press the circular magazine lock button (Fig. 13-10) at the top-right side of turret housing. Tilt magazine up and forward until it is flush with the camera plate. 3. Release the magazine-lock button and check the magazine for proper seating. If the lock button is not quite flush with the side of the camera and the magazine is tight, it is secure. 4. Push the locking cam at the top of the camera toward the eyepiece (to the left) and force the wedge into the top of the magazine recess.

To remove:

1. Push locking cam away from the eyepiece (to the right) to unlock the wedge. 2. Hold magazine. Depress the circular magazine-lock button. 3. Lower the back of the magazine. Remove.

13.7l Tachometer

None. Correct fps rate is determined on the governor-controlled (constant-speed) motor by observing the glowing pilot lamp on the left side of the motor. When the lamp flickers or goes out, the motor is out of synchronism (see Sec. 13.7b).

13.7m Shutter: Variable; 5–180°.

To change shutter opening:

1. Either remove taking lens or unlock turret and set it in a horizontal position. 2. Turn shutter control lever to "REFLEX." 3. Rotate the inching knob until the leading edge of the shutter reaches the left side of the aperture (nearest the eyepiece). 4. Turn the shutter-control lever down to "REGLAGE OBTURATEUR" (shutter adjustment) and hold. 5. Push the raised variable–shutter-control knob *in* and turn it until the desired shutter setting appears on the scale along the edge of the mirror. 6. Release the shutter-control knob, and

return the lever back to "MOTEUR" (motor). 7. Check the adjustment often.

13.7n Lubrication

None. All bearings and gears are permanently lubricated.

13.7o Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

CAUTION: Use *only* the bulb syringe on the reflex mirror, as the silver is delicate and lifts easily.

Manufacturer recommends the following maintenance *each time magazine is changed:*

1. Remove emulsion build-up with orangewood stick. 2. Wipe plates with chamois or soft cotton handkerchief (not linen). 3. Clean single pulldown claw spring with soft brush. Avoid entering into slot.

CAUTION: The spring can be knocked out when cleaning it. Repair is a factory job.

13.7p Weight: (with 400-ft load) 21 lb.

13.7q Troubleshooting

Trouble	*Probable Cause*
High-speed whirr	REFLEX lever not set to "MOTEUR" (motor)
Knocking noise	Film jam or lost loop
Pilot light out while camera is running	Low battery or battery cold
Bloop light stays on in eye-piece	Low battery
Pilot light remains on after camera is turned off	Relay not pulling; low battery
Camera will not start	Dead battery; power line faulty
Camera stops while filming	Film jam
Perforation tear, accordion pleat	Dirty pressure plate; loop uneven
Motor runs at excess speed	Transistors burned out by overload of battery voltage
Motor smells of "burning"	Wrong polarity of plugs
Magazine "chatter"	Lost loop
Noisy camera "grind"	Shrunken film stock; loose magazine
Clutch "chatter"	Magazine jam

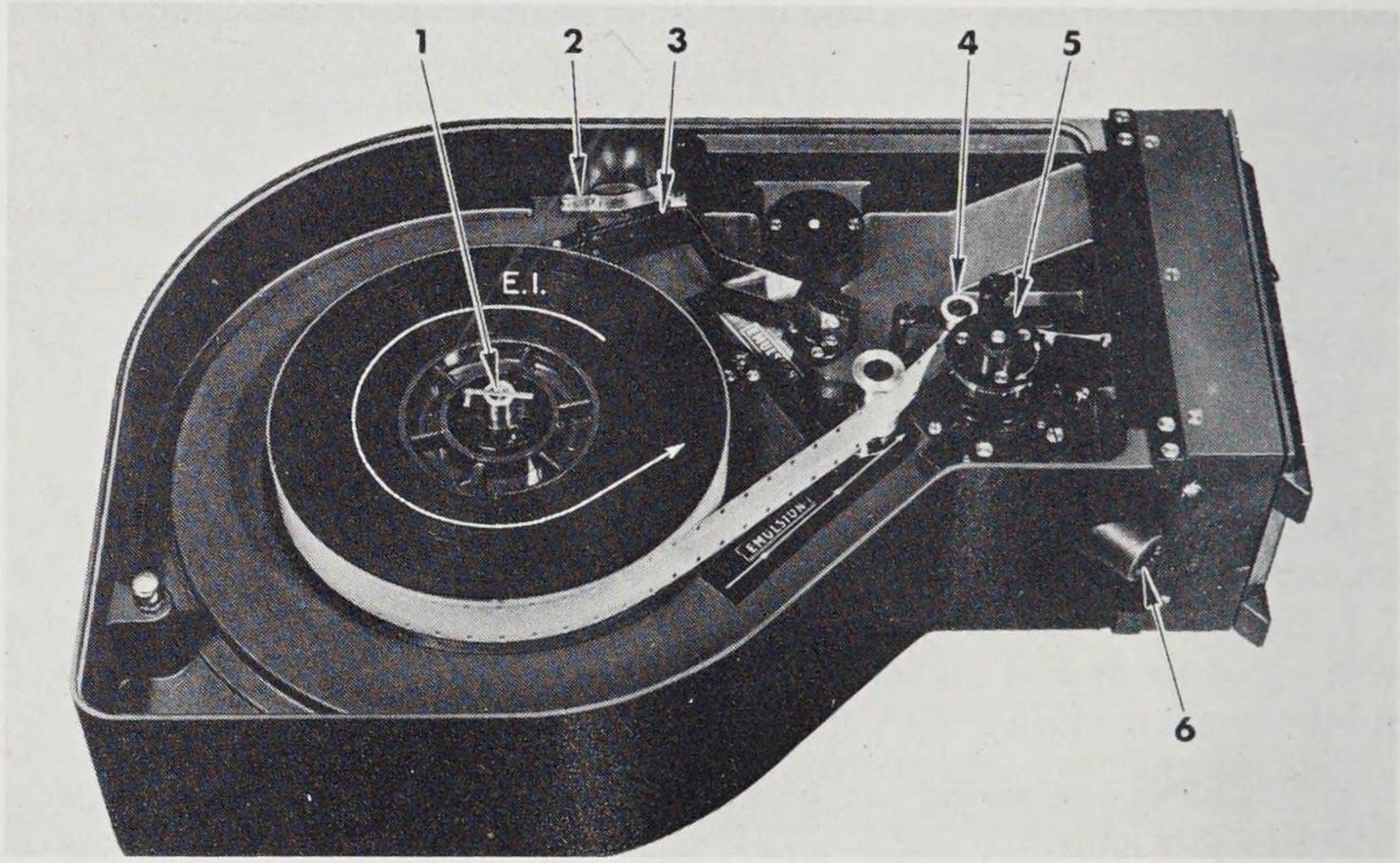


Fig. 13-12. Eclair NPR magazine (feed side). Courtesy of Eclair International Diffusion.

1. Spindle lock
2. Spring-arm holder
3. Footage-counter arm
4. Feed sprocket-guide roller
5. Feed sprocket wheel
6. Magazine drive shaft

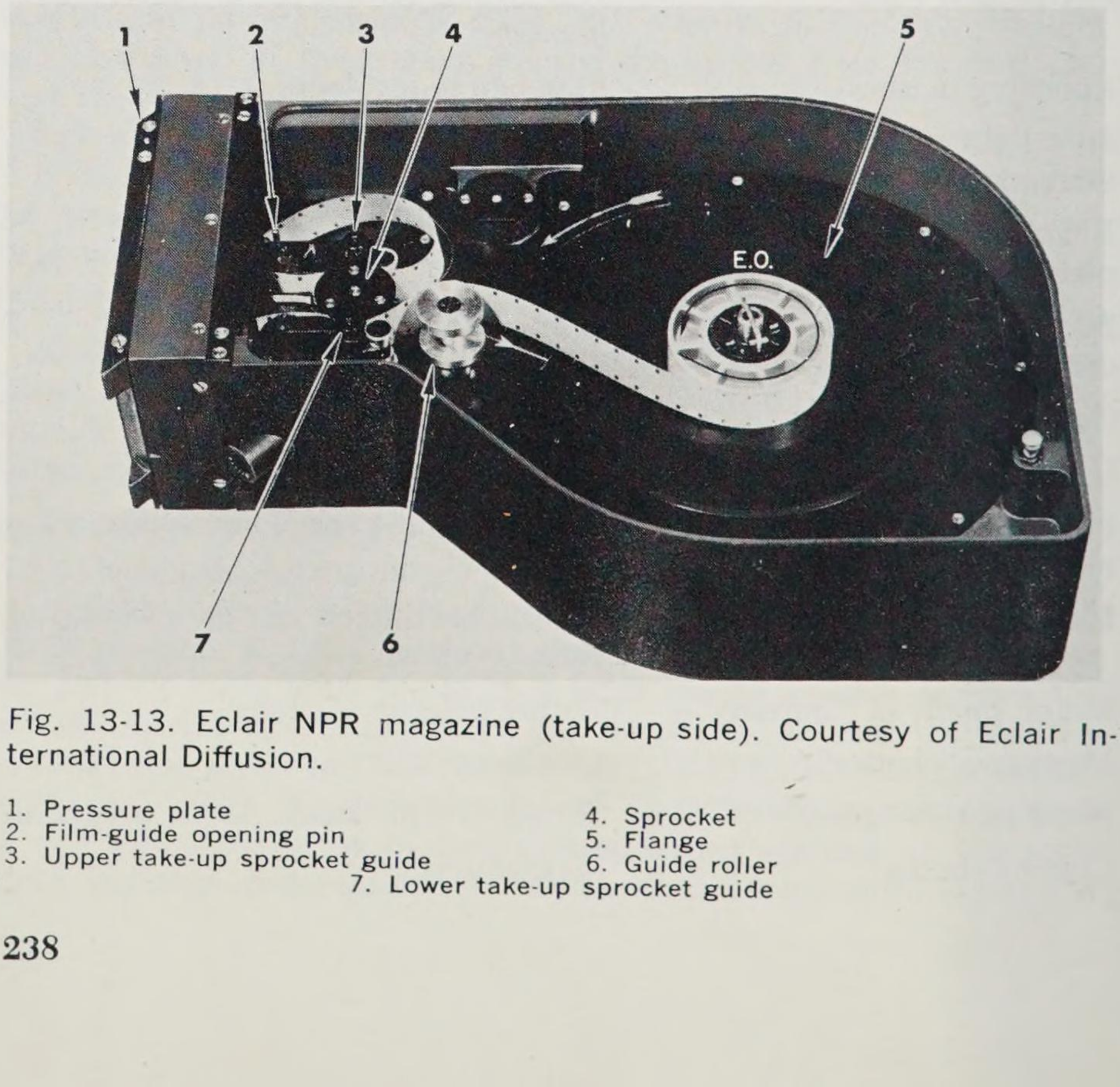


Fig. 13-13. Eclair NPR magazine (take-up side). Courtesy of Eclair International Diffusion.

1. Pressure plate
2. Film-guide opening pin
3. Upper take-up sprocket guide
4. Sprocket
5. Flange
6. Guide roller
7. Lower take-up sprocket guide

13.8 ECLAIR NPR 16 MAGAZINE (Figs. 13-12, 13-13)

13.8a Type: Coaxial.

13.8b Capacity: 400-ft.

13.8c Lids

Two. Located at each side of magazine, which is divided longitudinally. Both lids are lip- and dog-locked.

To remove: Slide safety lock toward rear of magazine. Push lock button down. Lift rear of magazine up and off.

13.8d Feed

Right half. (Magazine pressure plate should be at the loader's right, the magazine drive shaft toward the loader, and the footage counters away from the loader.) Film (wound emulsion in) pulls off spindle counterclockwise. Film (wound emulsion out) pulls off spindle clockwise.

NOTE: Feed interior is scribed with both emulsion-in and emulsion-out guide lines. Film wound emulsion-in should be loaded as pictured.

13.8e Take-up

Left half. (Magazine pressure plate should be at loader's left, the magazine drive shaft toward the loader, and the footage counters away from the loader.) Film winds on spindle counterclockwise, emulsion always out.

13.8f Loading

1. (Fig. 13-12) Remove feed lid. Swing footage-counter arm toward top of magazine and lock it into the spring-arm holder. 2. In darkness, remove film roll from can and bag. Place film, emulsion in, on the supporting flange (which rides the feed spindle) and pull film off the roll counterclockwise.

CAUTION: When loading single-perforated (B-wind) film, perforations must be toward lid on the feed side, away from the lid on the take-up side.

3. Lift sprocket-guide roller and push the guide *up* toward the top of the magazine. Place a few inches of film *between* the sprocket wheel and sprocket-guide roller. Depress guide to engage film on the sprocket. 4. Replace feed-side lid. Slide the right-hand side of the lid under the magazine lip and push down firmly. Cover will depress the pin on the spring-arm holder and release the footage-counter arm, which will drop onto roll. Check lock by attempting to lift the lid with the fingernails. 5. Flip the magazine over and remove the take-up lid.

NOTE: Take-up loading may be done in the light.

6. (Fig. 13-13) Rotate take-up spindle counterclockwise to transport film through the upper channel. Wind sufficient film through and follow scribed film-guide lines. 7. Lift upper take-up sprocket guide. Push guide *up* (toward top of the magazine). Insert film *between* the sprocket and upper take-up sprocket guide. Push guide down to

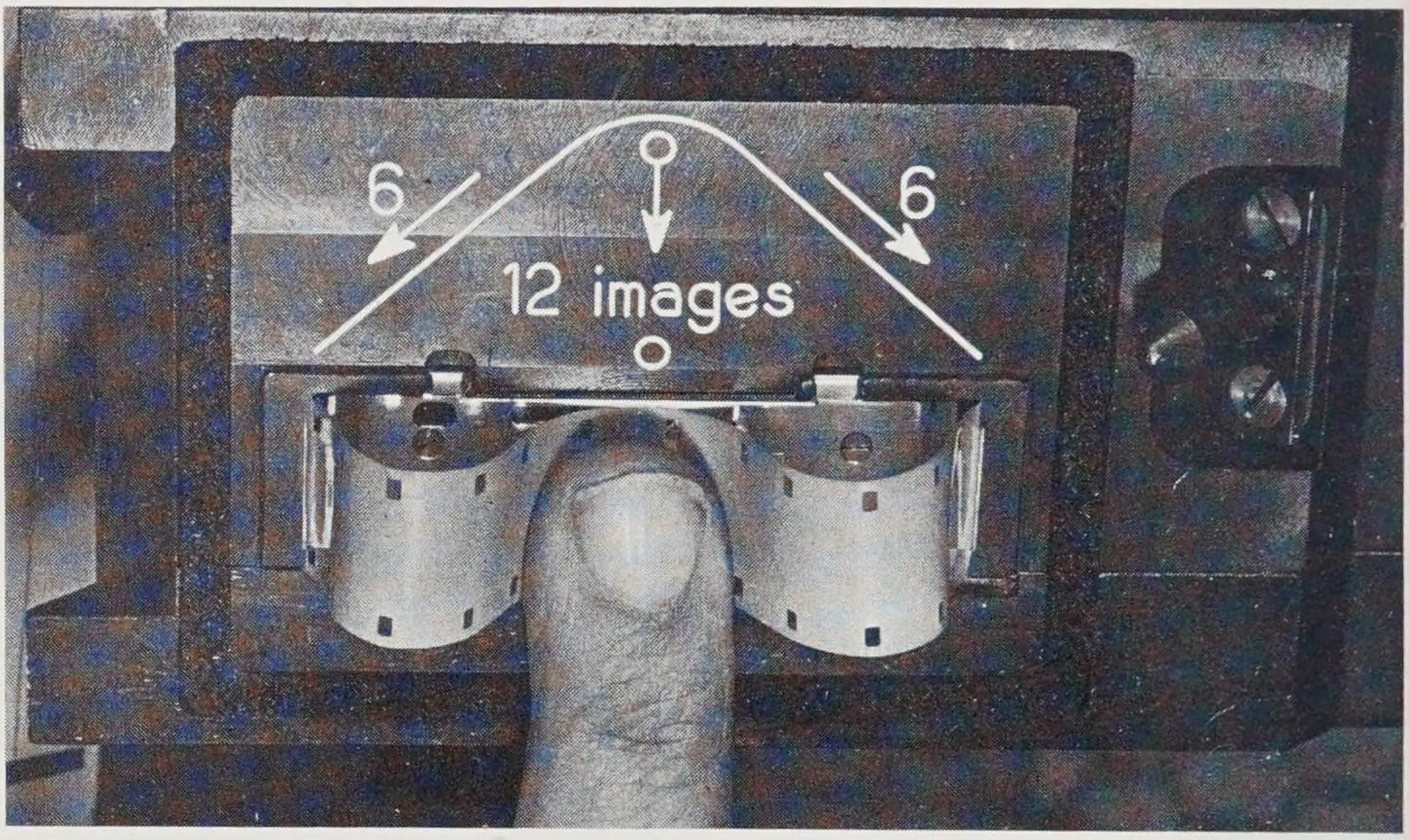


Fig. 13-14. Eclair NPR–dividing the loop. Courtesy of Eclair International Diffusion.

engage film on sprocket. 8. Push top of pressure plate in. Rotate take-up spindle counterclockwise until approximately 2-1/2 ft of film exits the magazine take-up side above the pressure plate.

CAUTION: It is very important that the film be taut between the sprocket and top pressure-plate exit.

9. Release top of pressure plate. Push bottom of pressure plate *in.* Place two fingers over the pressure pads (forefinger against the pads). Insert film end below the pressure plate and draw the film into the magazine take-up side again. Hold film taut against the index finger (the two fingers provide a rough guide for setting the 12–13-frame loop). 10. Keeping fingers in place, lift lower sprocket guide and push the guide toward the bottom of the magazine; insert the film *between* the sprocket and lower sprocket guide. Push the guide *up* to engage film in the sprocket. 11. Remove the two fingers from between the film and pressure plate. An arc of 12–13 frames should be outside the magazine; if not, adjust. 12. Place any excess film which may be *inside* the magazine *over* the guide roller (follow scribed line). Wind film counterclockwise (emulsion out) onto take-up core. Insert core onto spindle, allowing little or no slack. 13. To check threading, rotate magazine drive shaft clockwise. 14. Slide left hand of lid under magazine lip; push down firmly and engage. Slide safety lock on lid toward pressure plate.

NOTE: On older magazine with the tension knob in the door, rotate the tension knob counterclockwise to remove slack.

15. *To set loops* (Fig. 13-14): Press the forefinger into the center of the 12–13-frame arc to form two equal halves which, when pushed back into the magazine, will form the upper and lower internal loops. (There should be six frames for the top loop, six to seven frames for the bottom loop.)

NOTE: (a) Flanges in newer magazines are held in place by a spindle lock (Fig. 13-12) that fits horizontally across the top of the spindle. Older magazines merely hold the cores by pressure fit. Flanges are removed from the magazine when daylight spools are loaded into the magazine. (b) Older magazines are equipped with flange-ejector buttons in the feed and take-up sides. Newer magazines do *not* have ejectors.

13.8g Unloading

In darkness, remove lid. Place index finger on core, thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

13.8h Footage counters

Two sets. Located at top of magazine. Subtractive in both feet and meters, in increments of 5 ft and 2 meters. One set of counters, marked "ROULEAU," registers the amount of film on a darkroom-core load. The other counter, marked "BOBINE METAL," registers the amount of film on a daylight spool.

CHAPTER 14

Kodak® Reflex Special Camera and Magazine

14.1 16mm KODAK® REFLEX SPECIAL CAMERA

(Figs. 14-1, 14-2)

NOTE: All directions are from the Operator's point of view.

14.1a Base

Bottom fitted with three ⅜"-16 tapped holes to accommodate tripod lockdown screw. Also fitted with guide-pin pilot holes for an animation adapter plate.

14.1b Motors: 115V 60 Hz synchronous.

To mount:

1. Raise the top motor lock. Lower the rear motor lock. 2. Align the spring-loaded recessed male coupling on motor with the slotted camera drive shaft. Slide motor up to camera. Rotate inching knob until key in motor coupling engages slot on camera shaft. 3. Push the top motor lock forward. Raise the rear motor lock.

The following motors are available for the Kodak Reflex Special:
Variable-speed motor: 110V AC/DC 60 Hz.
Synchronous motor: 115V AC 60 Hz (24 fps) single-phase.
Animation motor: 110V AC/DC 60 Hz.

NOTE: 1. There is *no* governor-controlled (constant-speed) motor manufactured for the Special. 2. Motors manufactured for the Special are 60 Hz only (*no* 50 Hz). 3. The variable-speed motor, and the animation motor are *not* manufactured by Kodak. However, the name of the fabricator of these two motors will be supplied by Kodak upon request.

14.1c Power line

Input to camera is inserted into recessed six-pin Amphenol plug at left rear of motor.

ON/OFF switch (rocker-type): In the power-line cable, which also contains a light to indicate there is AC to the camera.

FWD/REV toggle switch: Located at the back of motor.

14.1d Turret: Three-position (see Fig. 14-2). Accepts Kodak® Type-R lens mounts only.

To rotate: Depress turret lock lever at upper right of turret. Pull center turret knob away from the camera and rotate turret until the desired lens is in taking position. Push turret knob in and the lock lever *up* to secure turret. Lens aligned with the reflex viewfinder (nearest the camera door) is the taking lens.

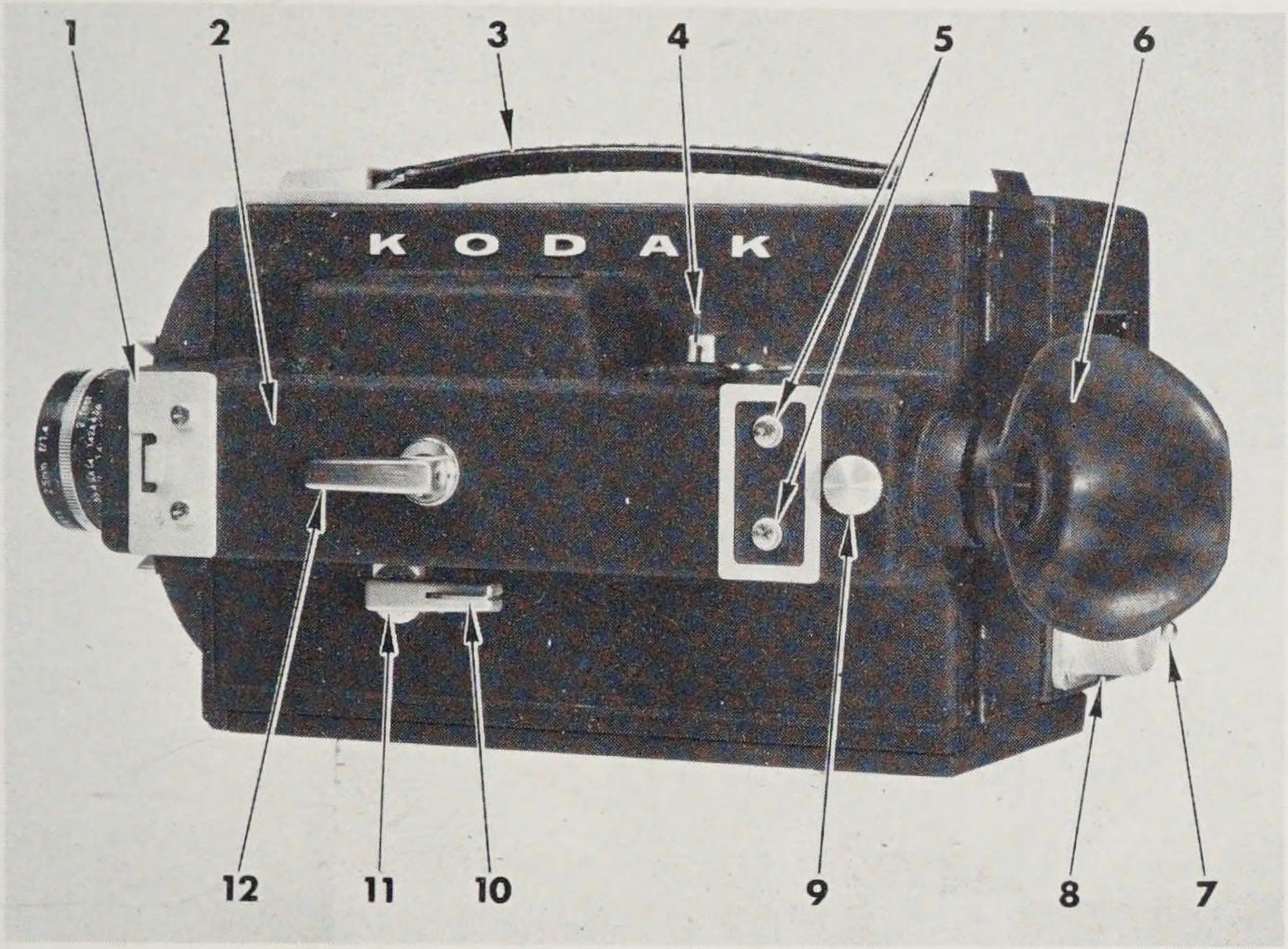


Fig. 14-1. Kodak Reflex Special (left side). Courtesy of Eastman Kodak Company, Inc.

1. Film-plane plate
2. Reflex viewfinder
3. Carrying handle
4. Light trap
5. Rear screws for offset-viewfinder bracket
6. Eyepiece
7. FWD/REV toggle switch
8. Power plug
9. Eyepiece locking screw
10. Door latch lock
11. Door latch
12. Magnification change lever

14.1e Lenses: Type-R mounts.

To mount lens on turret: Depress lens-clamp "ears" above and below the turret port. Align the key on the lens mount with the keyway in the port. Insert lens into port and release lens clamp "ears."

NOTE: To use Eastman Type-S lenses on the Reflex Special requires an "S-to-R" adapter. However, only Type-S mounts that fit the S-mount template can be used. (The "S-to-R" adapter and the template are considered standard equipment with each camera).

To use S-mount template: Set Type-S lens to infinity. Place template opening over the rear element of the lens. Abut the two surfaces at the open end of the template to the seating surface of the lens. If there is no interference between the template and the lens, the lens can be used on the camera.

14.1f Viewfinder: Reflex (see Fig. 14-1). Magnifies 10×. Views full field.

Eyepiece: Release knurled eyepiece locking screw at left rear of viewfinder. Rotate eyepiece until groundglass cross hair is sharp.

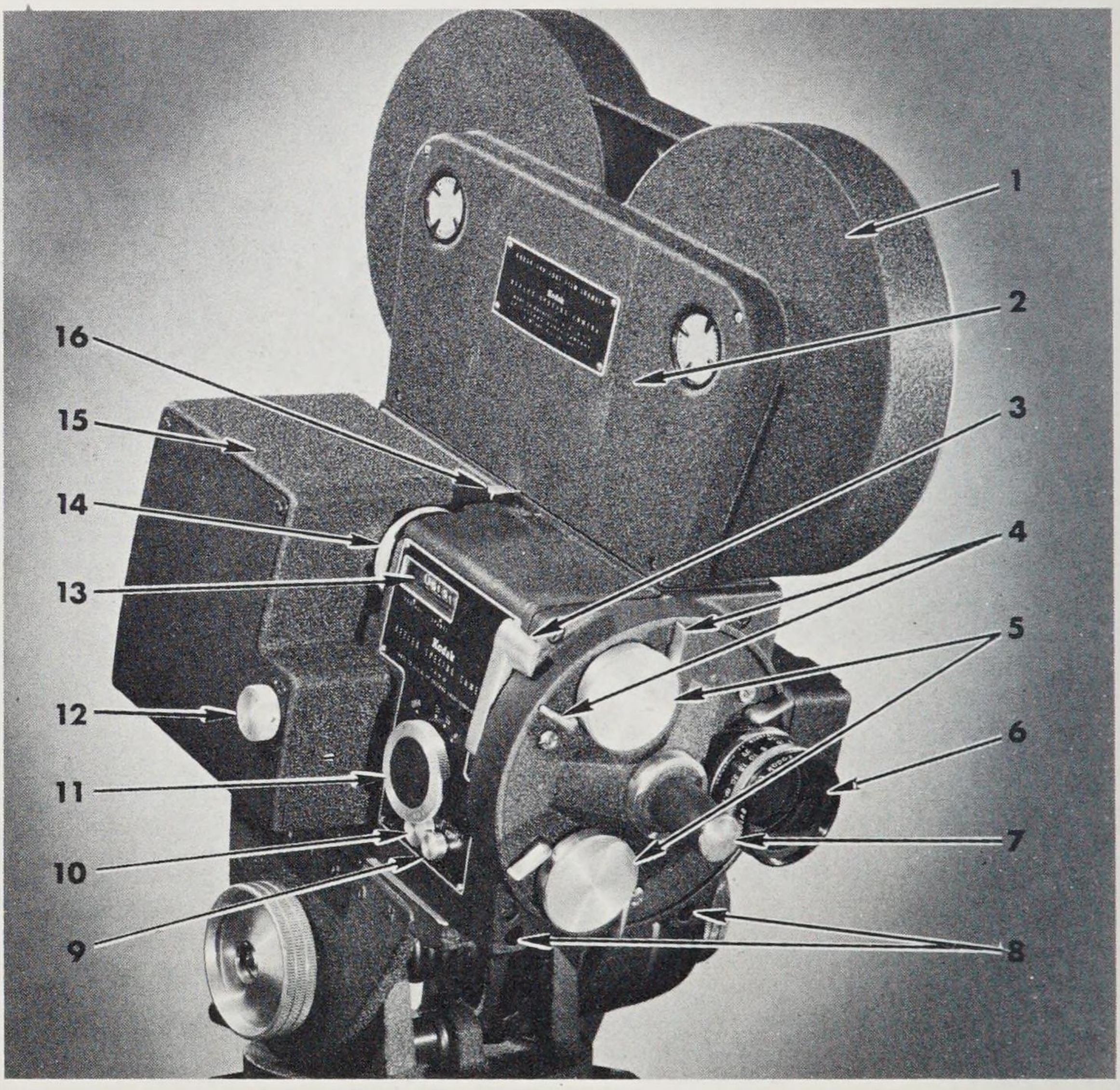


Fig. 14-2. Kodak Reflex Special with matte box removed. Courtesy of Eastman Kodak Company, Inc.

1. 400-ft magazine
2. Gilmer belt housing
3. Turret lock lever
4. Lens-clamp ears
5. Lens ports (capped)
6. Taking lens
7. Turret knob
8. Sunshade/matte-box bracket mounting holes
9. Shutter knob release
10. Shutter detent knob
11. Shutter-adjustment knob
12. Inching knob
13. Footage and frame counter
14. Footage-counter reset knob
15. Motor
16. Top motor lock

To align reflex mirror for viewing: Rotate inching knob at right front of motor (see Fig. 14-2).

Groundglass: Located at film plane. Adjustment is critical, therefore, it is recommended that a camera technician change and bench-check the unit.

To clean: Insert brush or blower into lens port or side groundglass window.

Magnification: Rotate magnification-change lever at *side* of viewfinder counterclockwise (up and forward). Magnifies 20×.

Light trap: At top of viewfinder forward of eyepiece. Depress the

release-lock blade in the finder shutter lever. Rotate the lever counterclockwise to close so that stray light cannot strike mirror and "kick back" onto film.

Offset viewfinder (not shown): If an offset viewfinder is desired on the camera, an Eastman finder bracket, into which a Mitchell NC-type viewfinder (see Sec. 16.3h) can be fitted, mounts onto the camera door (over the magnification lever). The magnification lever is then actuated by turning keyed blades located at the top and bottom of the bracket.

To place Eastman finder bracket on camera: Remove four Phillips-head screws and film-plane plate from the side of the reflex viewfinder/focus tube. Place the bracket over the tube with the dovetail forward, and secure the four Phillips-head screws.

14.1g Sunshade/matte box (see Fig. 14-2)

Mounts on two rods that fit into a bracket. Fit the bracket to the bottom front of the camera base (see Fig. 14-2) with two 1/8-in. knurled hex-head bolts.

14.1h Filters

Two 2 × 2 in. glass filters are housed in the sunshade only. No internal filter slot.

14.1i Door: Hinged at rear.

To open: Depress lock blade in door latch (located below the reflex viewfinder) and rotate the latch clockwise. Swing door laterally until hinge inside the door locks it open.

To close: Depress door stop-lock (in hinge slot) at bottom of door (see Fig. 14-3), and press door flush with camera. Push door latch *up*.

14.1j Magazine: 400-ft.

To mount:

1. Open camera door. Pull cover-release lever at top rear of camera interior (see Fig. 14-3). Raise dust cover/carrying handle and slide it back. 2. Pull a loop from the magazine feed side. Insert magazine toe into the magazine guide groove (at top of camera). Draw the film loop into camera. 3. Slide magazine forward and down until the recess in the magazine heel aligns with cover-release lever. Push cover-release lever to lock magazine to the camera. Thread camera (see Sec. 14.1k).

To remove: Unthread and break film. Pull cover-release lever at top rear of camera interior. Raise magazine, pull back and off.

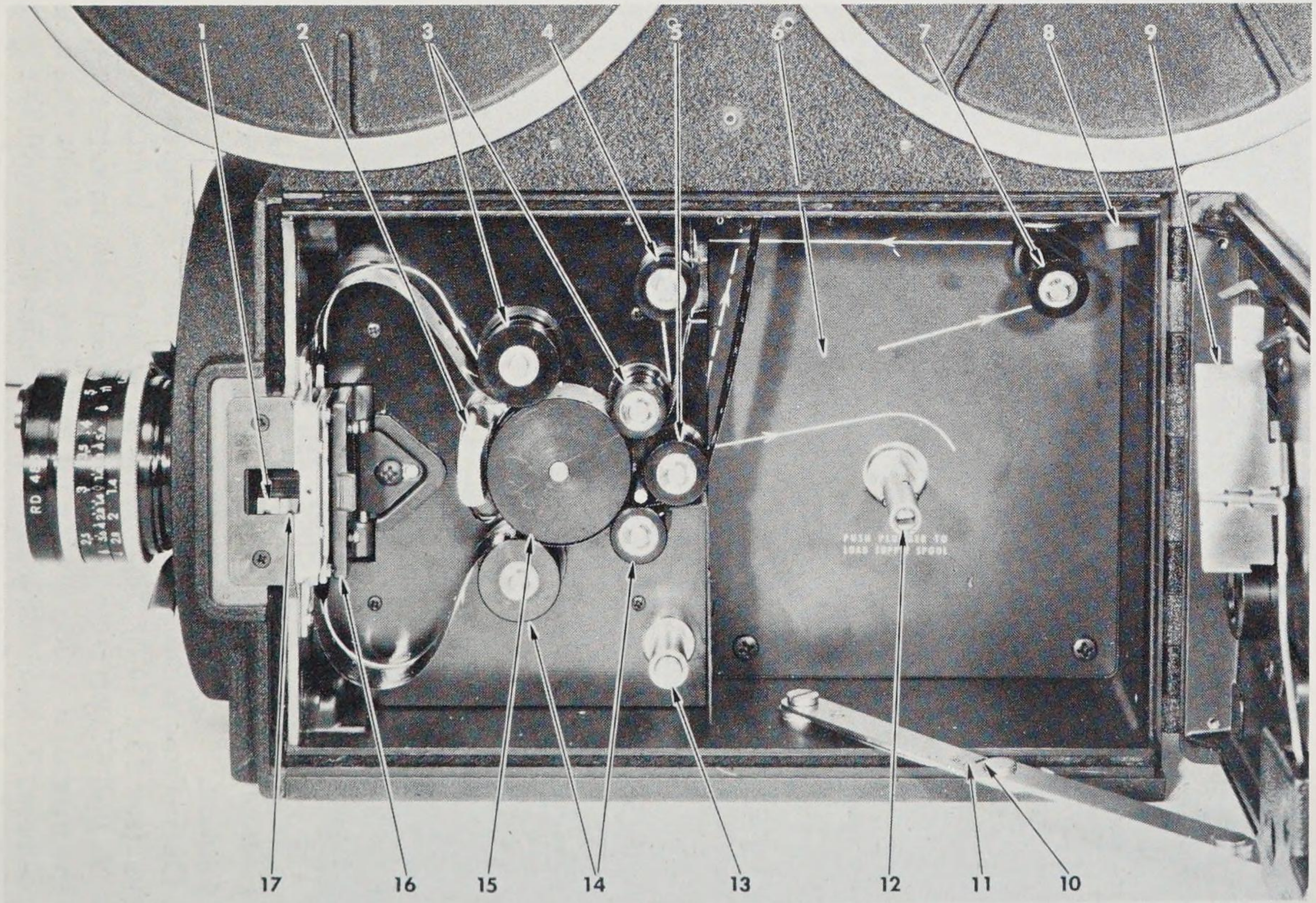
14.1k Threading (Fig. 14-3)

1. Pull power plug or turn camera power switch to "OFF" to avoid accidental starting of camera during threading procedure.

> CAUTION: Although the buckle-trip switch located below the sprocket automatically cuts out power when the door is opened, if it is accidentally hit with the power switch in the ON position, camera will start.

Fig. 14-3. Kodak Reflex Special (threading detail). Courtesy of Eastman Kodak Company, Inc.

1. Side groundglass window
2. Sprocket-roller lock
3. Upper sprocket-guide rollers
4. Movable guide roller
5. Center guide roller
6. Spool compartment
7. Upper right roller
8. Cover-release lever
9. Actuating plate
10. Hinge slot
11. Stop lock
12. Spindle plunger
13. Buckle-trip
14. Lower sprocket-guide rollers
15. Sprocket
16. Pressure pad
17. Groundglass



2. Depress the pressure-pad catch to swing the hinged pressure pad open. Check pad and gate for emulsion build-up or film chips. 3. Rotate inching knob to "OPEN" or until single pulldown claw retracts from the gate. 4. Draw the film loop into camera body and extend it to left front of camera (a rough guide for amount of film necessary for threading). Insert film into gate. Hold film with thumb and forefinger above and below the gate. Rotate inching knob until pulldown claw engages perforation. Close pressure pad.

CAUTION: It is extremely important to double-check to be sure that the pulldown claw is engaged and the gate closed!

5. Push sprocket-roller lock *down* to raise the upper sprocket-guide rollers until they are clear of the sprocket. Push the movable guide roller (nearest the magazine feed throat) *forward*. 6. Insert film: (a) To right of movable guide roller. (b) *Between* small upper sprocket-guide roller and sprocket. (c) *Between* large upper sprocket-guide roller and sprocket. 7. Push sprocket roller lock *up* to drop lower sprocket-guide rollers until they are clear of sprocket. 8. Insert film: (a) *Between* large lower sprocket-guide roller and sprocket. (b) *Between* small lower sprocket-guide roller and sprocket. (c) *Under* center guide roller. 9. Remove excess film slack by rotating magazine take-up spindle wheel counterclockwise. 10. *Center the sprocket-roller lock!* 11. Rotate the inching knob and observe film being transported in camera. If satisfactory, proceed to step 12. 12. Turn power switch to ON. Depress buckle-trip for short bursts and observe action of film. If satisfactory, proceed to step 13. 13. Stop camera, rotate film-buckle–actuating plate on door *downward*. Close door, reset the footage counter.

To load 100-ft daylight spools: 1. Unroll approximately 2 ft of film from the supply roll. Depress spindle plunger to retract ball bearings in spindle shaft; slide spool on spindle shaft until square hole in spool fits on square driver pin and film comes off the spool and follows the threading line scribed in the camera.

NOTE: Film comes off spool in a clockwise direction.

2. Loop film to the right of upper-right roller located below the cover-release lever. 3. Push the movable guide roller toward *rear* of the camera. Loop film *over* the movable guide roller. 4. Thread camera as in steps 1–8, above, and *center the sprocket roller lock!* 5. Insert film end into the take-up spool. Slide take-up spool on the spindle shaft until it is held by the ball bearings.

CAUTION: Do not depress the spindle plunger! If spool goes beyond the ball bearings, film will not take up properly.

6. Check threading as outlined in steps 11–13, above—*except* that the actuating plate is turned *upward*.

To remove spools: Depress spindle plunger and pull spools out.

14.1l Buckle-trip

Located below the sprocket. Automatically cuts out power to camera when door is opened or film fails to take-up.

NOTE: The actuating plate in the door is an integral part of the buckle-trip system. It should be rotated downward for 400-ft rolls, upward for 100-ft daylight spools.

14.1m Footage and frame counters: At right side of camera forward of motor (see Fig. 14-1).

Footage counter: Additive. Registers each foot of film transported through the camera from 0 to 999 in increments of one foot, then reverts to zero and counts forward again. Counter may be reset to zero each time magazine is changed.

Frame counter: Registers 0–39 frames in increments of one frame, then reverts to zero and counts forward again. Resets to zero.

Reset knob: Large knurled disc located forward of motor. Rotate clockwise to zero the counters.

14.1n Tachometer: None.

14.1o Shutter

Variable; 0–170° (Fig. 14-1). Can be set in four positions only: open, 1/50 sec; half, 1/100 sec; one-fourth, 1/200 sec; closed, 0.

Shutter-adjustment knob: Located below footage and frame counters.

To change shutter opening:

1. Depress detent knob (knob is partially covered by knurled shutter-adjustment knob) and turn shutter lock knob from "LOCK" to "RELEASE." 2. Rotate dot on shutter-adjustment knob to desired shutter opening. 3. Return shutter lock knob to LOCK to avoid shutter "creep" while filming.

CAUTION: After releasing the lock knob, turn adjustment knob to ascertain that shutter is locked in place.

NOTE: For fades and dissolves in the camera, keep shutter lock at the release position to avoid catching the shutter at intermediate openings.

To clear shutter from focusing tube: Rotate inching knob on motor to OPEN.

14.1p Lubrication

Manufacturer's only recommendation: when film guide rollers do not turn freely, place one or two drops of oil on ends of roller shafts.

14.1q Cleaning

Optics: Clean with bulb syringe or camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Open pressure pad and check the plate and pad for emulsion build-up. 2. Remove emulsion build-up with orangewood stick. 3. Wipe gate with chamois or soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

14.1r Weight: (with 400-ft load) 25-1/2 lb.

14.1s Troubleshooting

Trouble	*Probable Cause*
Camera will not start	AC connection loose; buckle-trip not depressed; no proper take-up on magazine; motor not properly attached
Intermittent starting and stopping	Broken connection in power line; improper threading
Torn perforations or ripped film	Improper threading
Door will not close	Sprocket-roller lock not centered; top cover release not set toward rear of camera; actuating plate not in proper position (down for 400-ft roll; up for 100-ft spool); foreign matter in door recess
Viewing system blacked out	Shutter closed; light trap closed; lens cap on
Lens will not focus	Lens not seated; camera too close for minimum distance of lens; elements damaged
Cut-in on viewing tube	Shutter not clear of reflex mirror; internal optics damaged
No take-up, or sporadic take-up	Magazine take-up spindle loose; film loose on take-up core; intermittent power surge in line; Gilmer belt loose (see Sec. 14.2i for remedy)

14.2 KODAK® REFLEX SPECIAL MAGAZINE (Fig. 14-4)

14.2a Type: Double-compartment.

14.2b Capacity: 400-ft.

14.2c Lid: Two. Threaded.

To remove: Rotate counterclockwise.

14.2d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

14.2e Take-up: Right side. Film winds on spindle clockwise, emulsion always in.

14.2f Loading

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Place film roll flat on surface above magazine. Unwind, clockwise, approximately 18 in. of film. 3. Press supply light-lock lever (inside feed compartment) to separate feed rollers. Insert film end between internal roller and compartment wall. Push through light trap.

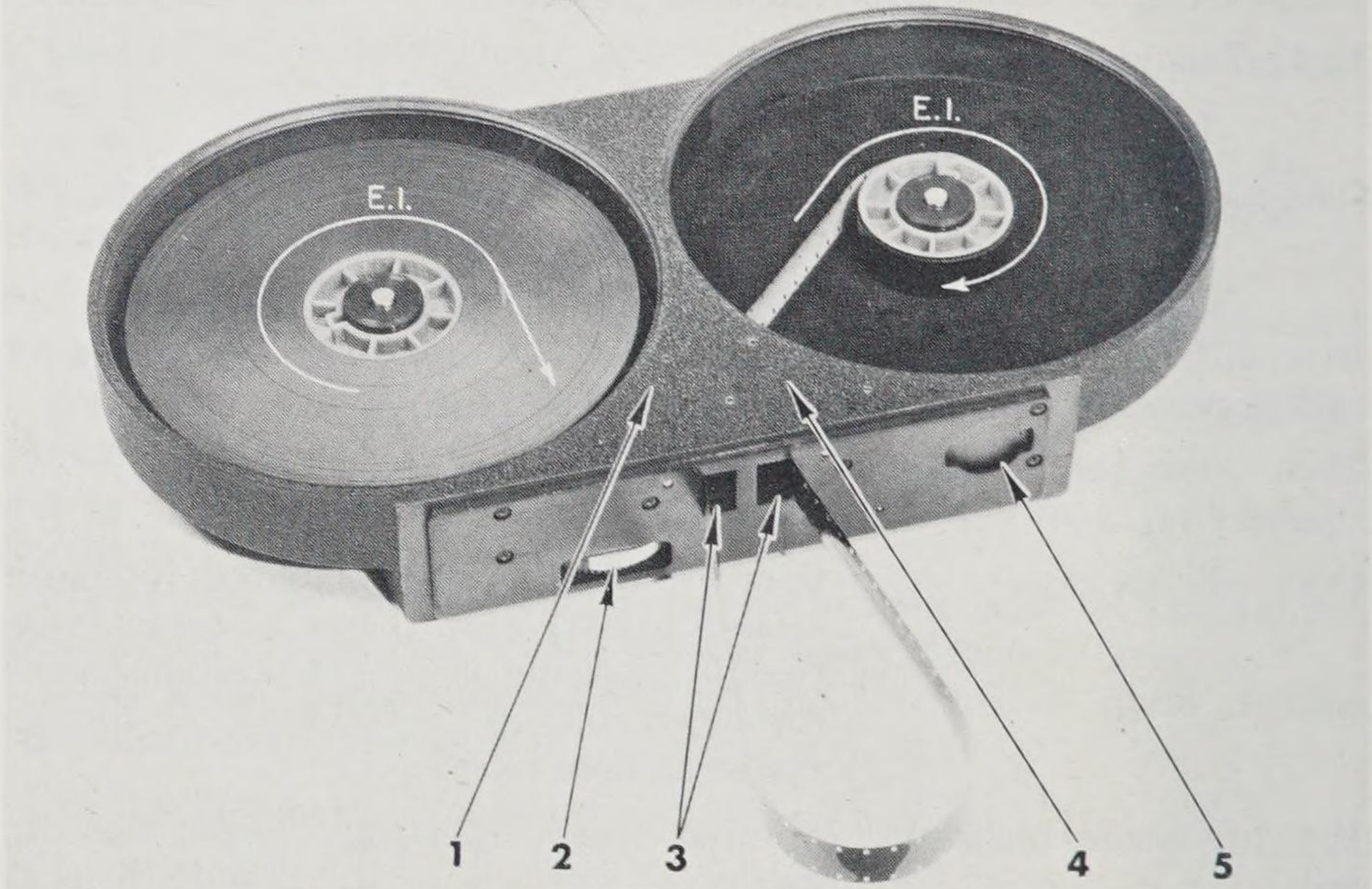


Fig. 14-4. Kodak Reflex Special magazine. Courtesy of Eastman Kodak Company, Inc.

1. Supply light-lock lever (inside compartment)
2. Gear drive
3. Light traps
4. Take-up light-lock lever (inside compartment)
5. Magazine lock hole

4. Grasp film end and hold. Place film roll on feed spindle. Rotate spindle wheel until spindle pin engages the core keyway. 5. Replace feed lid. 6. Unscrew take-up lid in light. Press take-up light-lock lever (inside take-up compartment) to separate take-up rollers. Insert film end through take-up rollers, then between compartment wall and internal roller. 7. Insert film end in core and wind on clockwise (emulsion in). Rotate spindle wheel until spindle pin engages the core keyway. 8. Replace take-up lid.

To load daylight spools: Pull core holders from spindles (straight up). Place spools on square driver pins of spindles.

14.2g Unloading

In darkness, unscrew take-up lid. Place middle finger on core, thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

14.2h Footage counter: None.

14.2i Gilmer-belt adjust

If magazine does not take-up, or take-up is sporadic: Remove four Phillips-head screws securing the Gilmer-belt cover to the back of the magazine (see Fig. 14-2). Loosen two Phillips-head screws securing the tension-adjustment roller plate. Raise the plate to apply tension on the Gilmer belt. Tighten plate screws. Replace cover.

CHAPTER 15

Maurer Camera and Magazine

15.1 16mm MAURER 150 CAMERA (Figs. 15-1, 15-2)

NOTE: All directions are from the Operator's point of view.

15.1a Base

Bottom fitted with one ⅜"-16 and one ¼"-20 tapped hole to accommodate tripod lockdown screws. The base is L-shaped and includes the turret. Flat section of base is fitted with a recessed track which allows camera to slide (rack over) horizontally to align the focusing tube with the taking lens.

15.1b Rackover

Camera box must be racked over to sight through taking lens (i.e., moved laterally to the right until focusing tube is directly behind the taking lens).

To rack over: Grasp knurled knobs on rackover handle at rear of camera (see Fig. 15-2). Rotate handle clockwise until camera seats itself at the right.

NOTE: A microswitch (not visible) cuts off power to the camera when it is in rackover position. Camera will *not* run until racked back to shooting position.

To rack back: Grasp two knurled knobs on handle at back of camera. Rotate handle counterclockwise until camera hits stops.

15.1c Focusing tube: Located in camera-box door.

Groundglass: None. Instead a clear-glass (aerial-image) cross hair is used for focus (see "Eyepiece," below). Scribe in tube denotes projector aperture. Full field denotes camera aperture.

Internal focusing turret (Fig. 15-3): Three-position. Knurled handle below front of focusing tube moves in an arc.

To view through and compose with all wide-angle lenses (15mm, 16mm, 17mm, 20mm): (See also Sec. 15.1i.) Push handle toward Operator (position no. 1).

To view and compose 25mm or longer lenses: (See also Sec. 15.1i.) Push handle to center (position no. 2).

Magnification: To magnify all lenses 140×: Push handle forward (position no. 3).

NOTE: Manufacturer recommends that all critical focusing be done with the lens stopped down to the aperture at which the scene will be photographed.

Eyepiece (Fig. 15-1): Rotates. Moves in and out. Adjusts to achieve focus on cross hair.

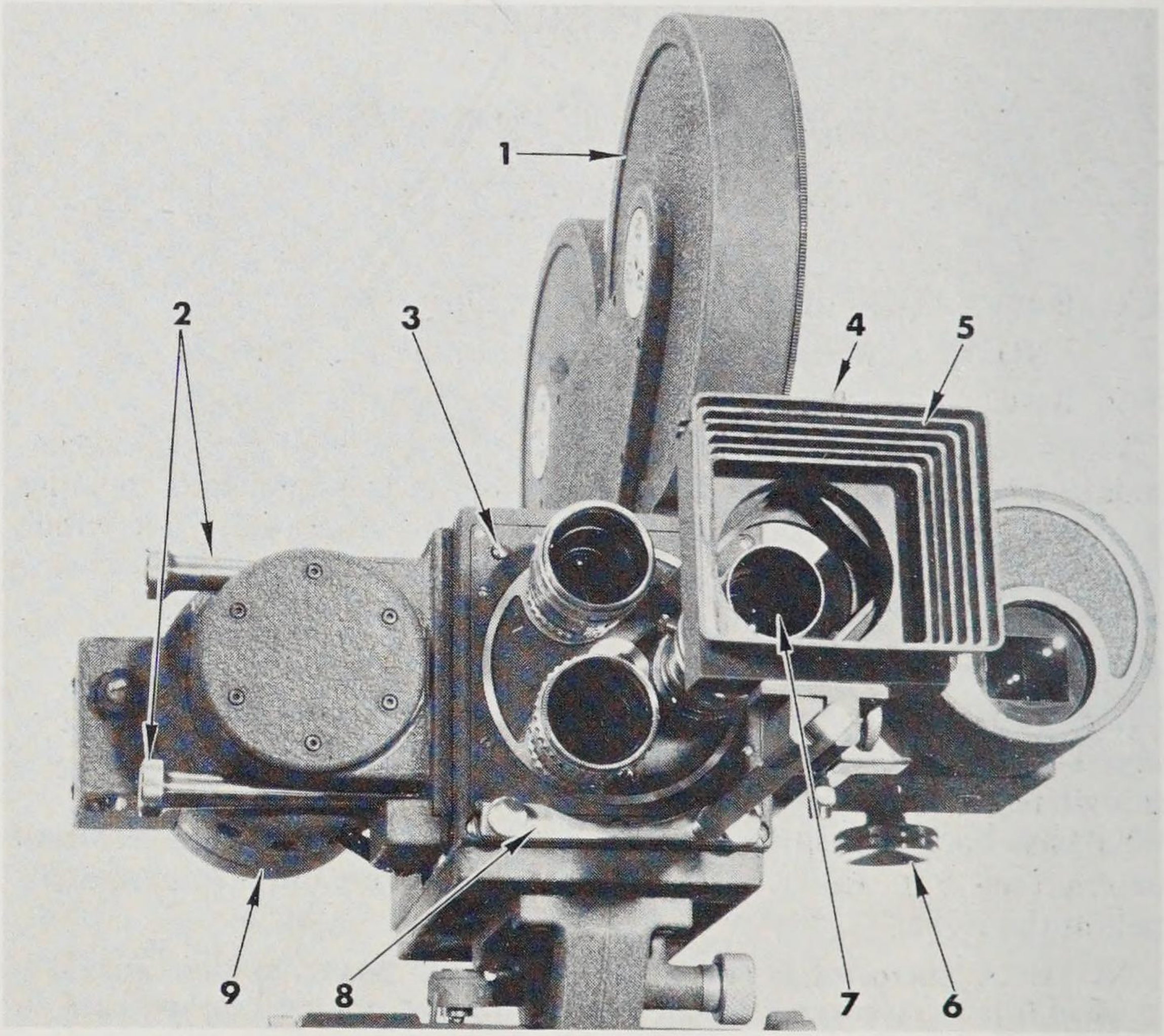


Fig. 15-1. Maurer 150 (front view). Courtesy of J. A. Maurer, Inc.

1. Geared magazine
2. Motor-mounting screws
3. Turret-release button
4. Extension-shade screw
5. Sunshade/matte box
6. Viewfinder focusing knob
7. Taking lens
8. Boom bracket
9. 110V synchronous motor

To focus:

1. Set internal-focusing-turret handle to center position (position no. 2). 2. Rotate eyepiece until *cross hair* is sharp.

CAUTION: A cross hair focused at positions no. 1 and no. 3 will *not* provide a correct setting.

15.1d Motors

Synchronous motors (shown): Have a manual motor-turning knob at the back.

Variable-speed motors (not shown): Have a manual motor-turning knob at the side. The governor control (rheostat) and the tachometer are located at the top.

NOTE: (a) The variable-speed motor does *not* reverse. (b) The variable-speed–motor tachometer registers 2–72 fps in increments of two frames per second.

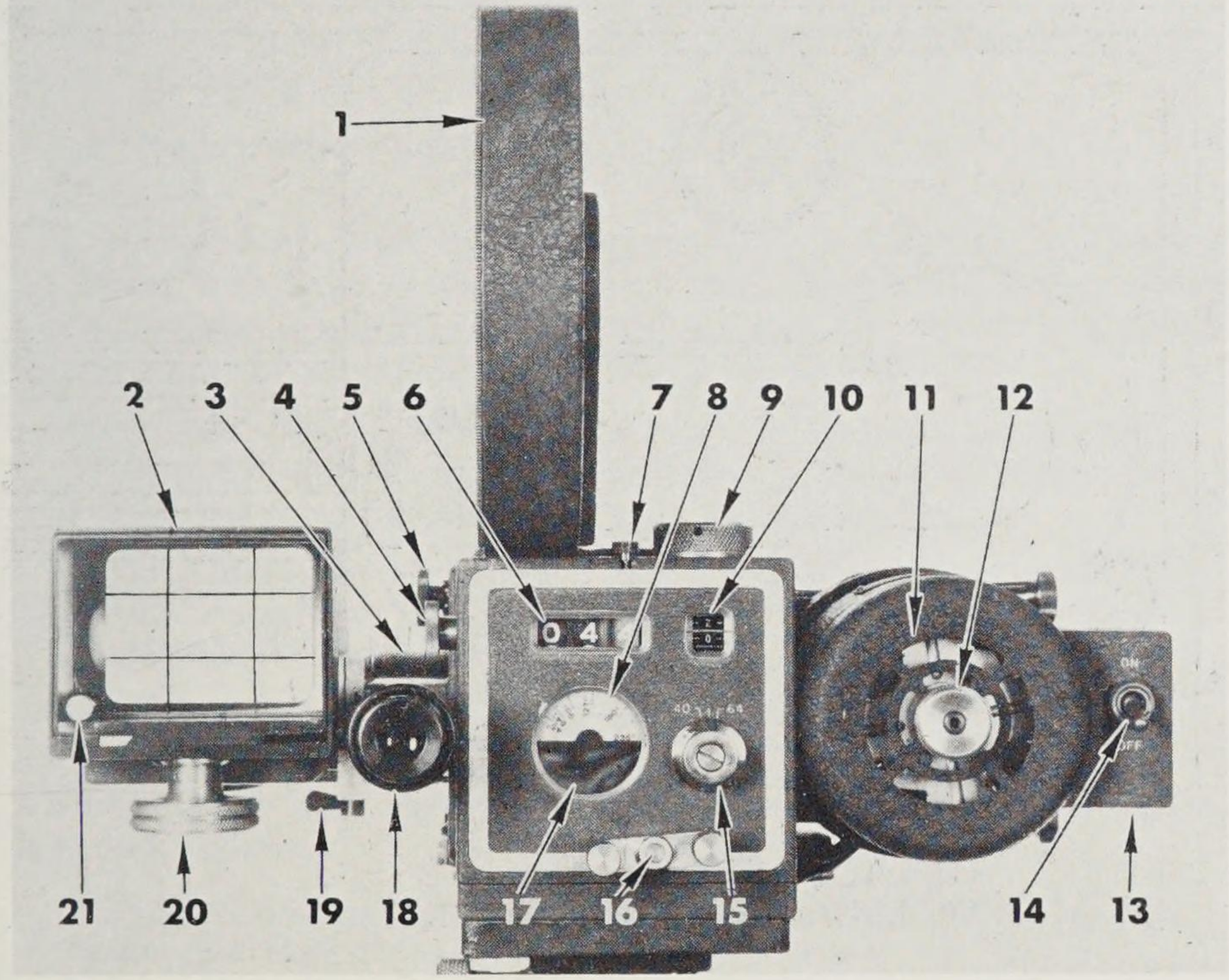


Fig. 15-2. Maurer 150 (rear view). Courtesy of J. A. Maurer, Inc.

1. Geared magazine
2. Viewfinder
3. Focusing tube
4. Footage-counter reset knob
5. Door knob
6. Footage counter
7. Camera-back lockscrew
8. Shutter indicator
9. Shutter-adjusting knob
10. Frame counter
11. Synchronous motor
12. Manual motor-turning knob
13. Power plug (not visible)
14. ON/OFF switch
15. Automatic fade knob
16. Rackover handle
17. Dummy shutter
18. Eyepiece
19. Viewfinder lock lever
20. Viewfinder focusing knob
21. Ribbon-matte adjusting knob

To mount synchronous or variable-speed motor:

1. Align the two long mounting screws (see Fig. 15-1) on the motor with the tapped holes at the right side of camera. 2. Rotate the manual motor-turning knob until drive coupling aligns with the movement drive shaft in camera. 3. Press motor snugly against the camera. Secure the mounting screws.

The following motors are available for the Maurer 150:

Variable-speed motor: 110V AC/DC 60 Hz; 110V AC/DC 50 Hz; 12V DC.

Governor-controlled (constant-speed) motor: 12V DC (24 fps).

Synchronous motor: 110V AC 60 Hz (24 fps) single phase; 110V

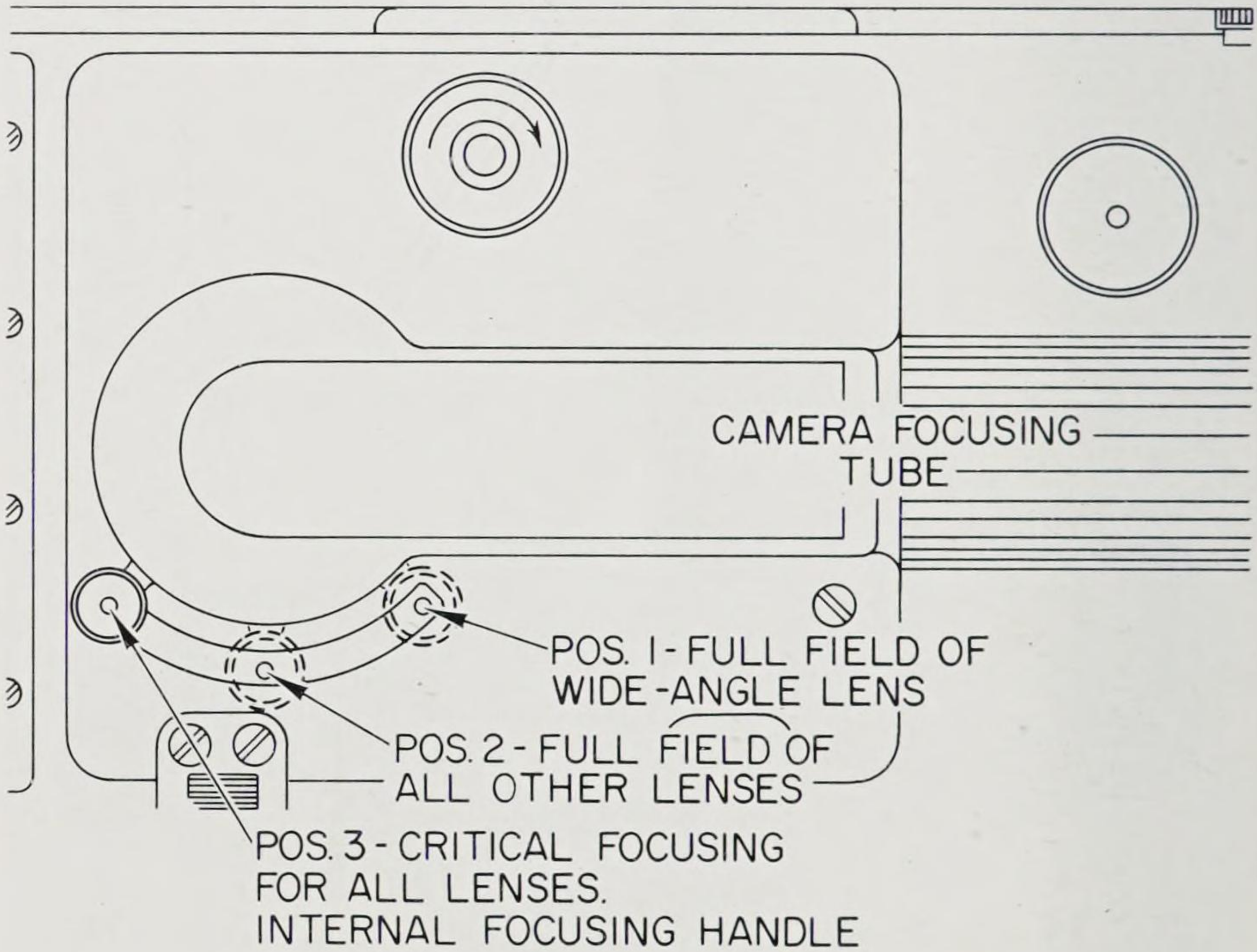

CAMERA FOCUSING TUBE
POS. 1 - FULL FIELD OF WIDE-ANGLE LENS
POS. 2 - FULL FIELD OF ALL OTHER LENSES
POS. 3 - CRITICAL FOCUSING FOR ALL LENSES.
INTERNAL FOCUSING HANDLE

Fig. 15-3. Maurer 150 internal focusing turret (detail). Courtesy of J. A. Maurer, Inc.

AC 50 Hz (24 fps) single phase; 110V AC 60 Hz (32 fps) single phase; 110V AC 50 Hz (32 fps) single phase; 220V AC 60 Hz (24 fps) 3-phase; 220V AC 50 Hz (24 fps) 3-phase.

Animation/stop motion motor: 110V AC/DC 60 Hz; 110V AC/DC 50 Hz.

NOTE: 25 fps governor-controlled (constant-speed) and 25 fps synchronous motors are available from the manufacturer on special order only.

15.1e Power line

Input to camera: Inserts into three-pin Cannon receptacle at bottom of motor.

ON/OFF switch:

Synchronous motor: Located at the back, near the manual motor-turning knob (Fig. 15-2).

Variable-speed motor: Located in the power cable.

15.1f Turret: Three-position.

To rotate: Depress turret-release button (upper right side camera front, Fig. 15-1), turn turret until desired lens is in taking position at right of viewfinder. Release button to lock turret.

15.1g Lenses: C-mount.

To fit lens to turret: Align threads with turret port. Rotate lens until seated. Fingertighten only.

15.1h Viewfinder: Offset.

To mount:

1. Rack camera back to shooting position. 2. Align rear of dovetail on finder with front of dovetail on camera door. Slide finder toward Operator until it is seated on the entire viewfinder dovetail. 3. Rotate lock lever below viewfinder counterclockwise to secure.

> CAUTION: Viewfinder is extremly heavy. A pneumatic door check is incorporated to avoid springing the hinges, nevertheless, when opening the door, grasp the finder and lower the door *gently*.

> NOTE: *Inside the viewfinder:* The ribbon-matte–adjusting knob is located in the lower left corner. An engraved focal-length index and a traveling indicator are at the top.

To adjust viewfinder ribbon mattes: Pull knurled ribbon-matte–adjusting knob. Rotate knob until the traveling indicator aligns with a scribe on the index that corresponds to the focal length of the taking lens. Release knob.

> NOTE: All four mattes and the indicator move in unison. The top, bottom, and sides of the frame are automatically set.

15.1i Parallax Adjustment

15–20mm lenses:

1. Rotate clockwise the large knurled viewfinder focusing knob, underneath the viewfinder (see Fig. 15-2), until the sliding tube inside the viewfinder housing is flush with the housing. Viewfinder is now set at infinity for 15–20mm lenses. 2. Set internal focusing turret knob to position no. 1 (toward the Operator). 3. Rack over and align focusing-tube cross hair with subject. 4. Rotate viewfinder focusing knob counterclockwise until cross hair in viewfinder aligns with the subject. Viewfinder is now in focus and parallax-corrected.

25mm or longer lenses:

1. Align sliding tube inside viewfinder housing flush, as in 15–20mm lenses (see above). 2. Continue rotating focusing knob clockwise. (Sliding tube will exit housing and "drop in" to a position parallel to the camera body—infinity.) 3. Set internal focusing tube to position no. 2 (center). 4. Rack over and align focusing-tube cross hair on subject. 5. Rotate focusing knob counterclockwise until cross hair in viewfinder aligns with subject. Viewfinder is now in focus and parallax-corrected.

> NOTE: Adjustment of viewfinder cross hairs (vertical and horizontal) cannot be done on the job. If the viewfinder cross hairs do *not* match the focusing tube cross hairs, the Operator must compensate for the discrepancy. A factory job is recommended for proper adjustment.

15.1j Sunshade/matte box (see Fig. 15-1)

No bellows. Sunshade/matte box mounts on a single boom on a bracket (see Fig. 15-1). Slides in and out only.

Boom bracket is independent of camera. Unit screws into the lower front of camera base.

Top of matte box is fitted with an extension shade screw.

To verify clearance:

1. (a) Sight through focusing tube. Run forefinger around inner edge of matte box. If fingertip is visible, move entire unit toward lens; or (b) Detach 2-in. filter-holder assembly. Slide matte box toward lens. 2. Repeat finger check until matte box is clear of lens.

NOTE: Long lenses may have to be removed from the turret in order to clear matte box from taking lens.

15.1k Filters

Holders accommodate two 3 × 3 in. glass filters or gelatine frames, and two 2 × 2 in. glass filters or gelatine frames in the matte box.

The back of the matte box is threaded to accommodate one Series 7 round filter or pola-screen.

No internal-filter slot.

15.1l Door: Hinged at bottom.

To open: Rotate knurled knob at top of door (see Fig. 15-2) counterclockwise.

CAUTION: With viewfinder attached, grasp viewfinder, and lower the door *gently*.

To close: Lift up until flush with camera. Rotate knurled knob in door clockwise.

15.1m Magazine: 400-ft and 1200-ft (shown).

To mount:

1. Pull a loop from the magazine feed side (approximately 4-in. long). 2. Hold the magazine above camera, lids *parallel to the back* of camera (magazine lids must face the Operator). 3. Insert the loop into take-up side of camera body. 4. Push the feed side of film loop through the accommodation slot at left of the tapped hole that accepts the magazine lockdown screw. 5. Turn the magazine and align it with the magazine guide groove. Lower magazine and secure magazine lockdown screw clockwise into camera. Thread camera (see Sec. 15.1n).

NOTE: If the magazine does not seat flush with the camera, rotate the manual motor-turning knob until the gears mesh.

To remove magazine: Unthread and break film. Rotate magazine lockdown screw counterclockwise. Lift magazine.

15.1n Threading (Fig. 15-4)

1. Gently move the buckle-trip knob to the right until shaft drops into a slot, to avoid accidental starting of camera during threading procedure. Rotate the forward and rear sprocket-guide rollers counter-

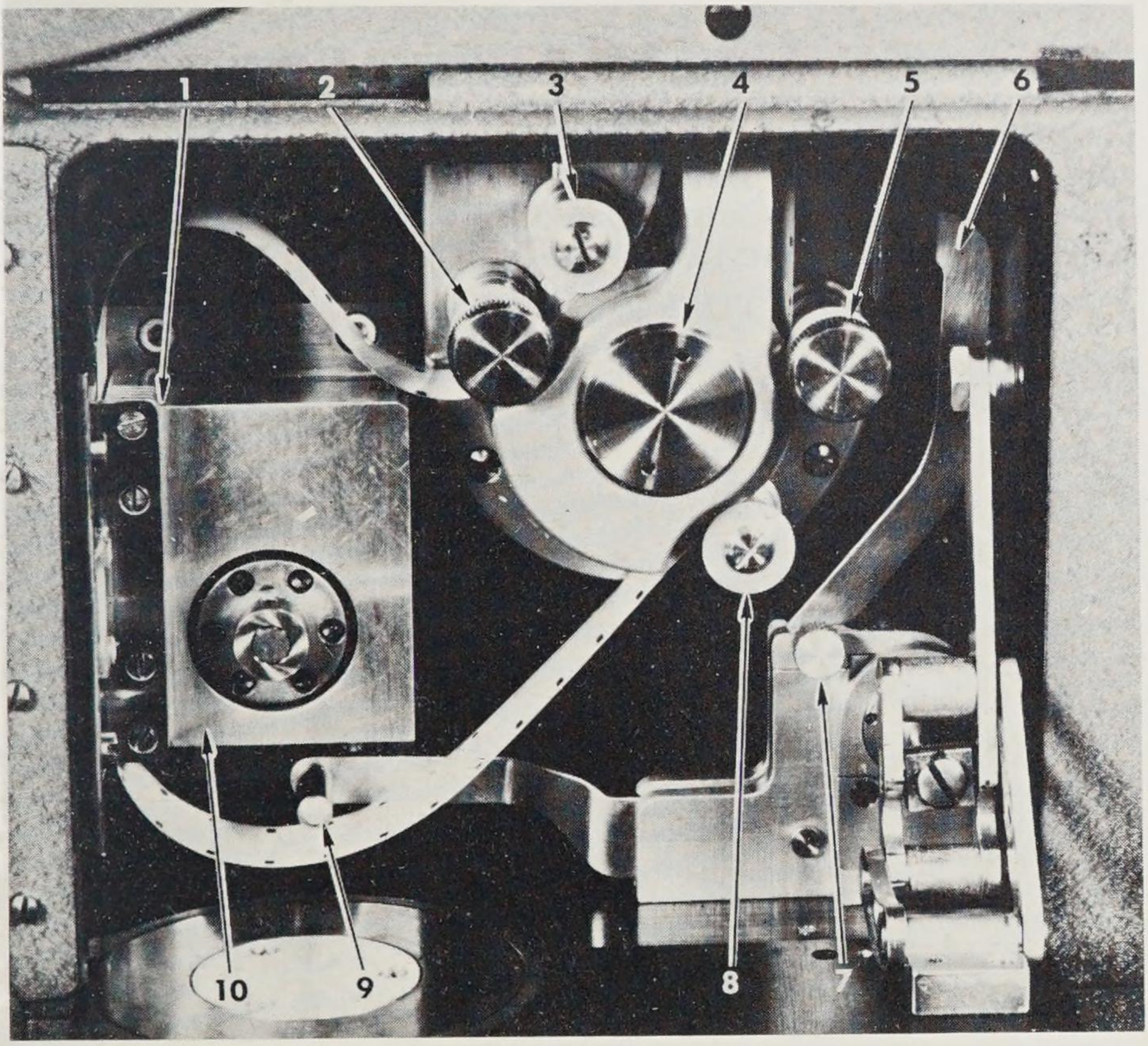


Fig. 15-4. Maurer 150 internal threading (detail). Courtesy of J. A. Maurer, Inc.

1. Film gate (swings outward)
2. Forward sprocket-guide roller
3. Upper feed roller
4. Sprocket
5. Rear sprocket-guide roller
6. Upper loop trip
7. Buckle-trip knob
8. Lower take-up roller
9. Lower loop trip
10. Lube hole (behind block)

clockwise. 2. Grasp top and bottom of hinged film gate with thumb and forefinger; pull outward. Swing gate until plate is 90° to the aperture. Check for emulsion build-up or film chips. Rotate manual motor-turning knob until single pulldown claw retracts from aperture plate. 3. Pull film from feed side. Extend loop to front corner of camera (a rough guide for amount of film needed for threading). Insert film: (a) To right of upper feed roller. (b) *Between* the forward sprocket-guide roller and sprocket. Close roller guide. 4. With middle finger and forefinger spread film and press it against the buttons at the top and bottom of the movement and forward of the pulldown claw. Then, (a) Adjust top loop so that when gate is closed, loop is approximately 1 in. from top of the loop (longer loop is not necessary). (b) Align film perforation with claw. Rotate manual motor-turning knob and engage claw in perforation. 5. Insert lower loop between lower take-up

roller, sprocket, and rear sprocket-guide roller. Adjust lower loop s that when rear sprocket-guide roller closes, loop will clear bottom c box by 1/8–1/4 in. at the lowest arc of the loop. Remove slack o the feed and take-up spindles. 6. Rotate manual motor-turning kno and observe film being transported in camera. If satisfactory, procee to step 7. 7. Reset buckle-trip and microswitch (see Sec. 15.1o). Hol sprocket-guide rollers with thumb and forefinger.

CAUTION: Keep knuckles clear of the movement!

Apply power in short bursts and observe action of film. If satisfactory stop camera, close door, and reset footage counter.

15.1o Buckle-trip

Knurled knob located below the sprocket drum assembly cuts ou power when tripped by hand or when film fails to take up properly Power should be deliberately cut out prior to threading by movin the buckle-trip knob to the right until the shaft drops into a slot. Thi will avoid the accidental starting of the camera during threadin procedures.

To reset: Raise buckle-trip knob until the shaft is out of the slo Move knob forward (left) into the shallow groove.

Microswitch: To reset, push the button located to right of the for ward (left) door hinge on camera base (not visible).

NOTE: Older model cameras do not have a buckle-trip or micro-switch.

15.1p Footage and frame counter

Footage counter: Located at back of camera above shutter indicato (see Fig. 15-2). Additive. Registers each foot of film transporte through camera up to 999 ft, then reverts to zero.

Frame counter: At right of footage counter. Additive in increment of one frame (every other frame numbered). Registers each frame 0–39, then reverts to zero and counts forward again.

Reset knob: For both counters—at left rear of door.

15.1q Tachometer: None.

15.1r Shutter

Variable; 0–235° (Fig. 15-2). Calibrations at back of camera i increments of one-half stop. Scribed settings on shutter indicator are 45°; 64°; 90°; 127°; 180°; and 235°. Settings in between these mus be estimated.

To change shutter opening:

1. Observe shutter indicator at back of camera (see Fig. 15-2)
2. Rotate knurled shutter-adjusting knob at top rear of camera (abov the frame counter) until desired shutter setting is reached.

Automatic fades: Two. Automatic-fade knob is located at back o camera. At desired fade-out (or fade-in) of scene, rotate knob counter clockwise for 40-frame fade, clockwise for 64-frame fade.

CAUTION: Manufacturer recommends: 1. Fades should not be made at speeds other than 24 fps. 2. At speeds greater than 24 fps, a 235° shutter opening should be used to avoid shutter creep (i.e., the slow closing of shutter while camera is running), unless a positive locking pin is installed on the shutter-control knob (a factory job).

Shutter creep can be readily observed by running the camera at the desired speed above 24 fps, and watching the action of the dummy shutter at the back of the camera (see Fig. 15-2).

To correct shutter creep (at speeds less than 32 fps):

1. Remove small knurled screw in center of automatic-fade knob. Remove the automatic-fade knob. Remove the camera-back lock screw at top rear. 2. Remove the back of camera. 3. Fit snugly (do *not* tighten) the small screw in the exposed shutter calibration. 4. Replace the back of the camera and the automatic-fade knob.

NOTE: *If shutter creep persists:* Older cameras—a factory repair job is indicated. Newer cameras (No. 300 and subsequent serial numbers): 1. Rack camera over to focus position. Turn camera *over*. 2. A hole in the base accepts a no. 8 hex wrench. Insert wrench through the base into camera box. Rotate wrench *gently*.

CAUTION: Too much tension will prevent proper operation of the automatic shutter. A trial-and-error method of tension adjustment is recommended. 3. Run camera at 32 fps, and observe shutter for creep. If creep continues, readjust until it stops.

NOTE: Once adjusted, the shutter can still creep at speeds higher than 32 fps. This is normal—unless a positive lock pin has been installed on the shutter-control knob.

15.1s Lubrication (Fig. 15-4)

Manufacturer recommends lubrication of the following parts every 10,000 ft with P-290 Esso (Beacon Oil Lubricant):

Movement: Swing film gate outward to expose camshaft and lube hole (not shown). Insert tip of tube in hole below the camshaft. Squeeze a small amount into hole and at the same time rotate the manual motor-turning knob.

NOTE: After lubricating, run camera to eliminate excess P-290; wipe clean.

After each high-speed run (above 32 fps), lubricate movement.

15.1t Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Open gate and remove emulsion build-up with orangewood stick.
2. Wipe gate with chamois or soft cotton handkerchief (not linen).
3. Use bulb syringe on camera interior to remove dust, dirt, etc.

15.1u Weight: (with 400-ft load) 37 lb; (with 1200-ft load) 50 lb.

15.1v Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Camera racked over; buckle-trip or micro-switch not reset; power-line connection faulty; low temperature
Viewfinder field does not match lens field	Viewfinder ribbon mattes not set; internal focusing turret not adjusted
Parallax not correct	Viewfinder not seated all the way on the door dovetail; viewfinder field not correct (see Sec. 15.1i); internal focusing turret at wrong position
Camera door will not close	Sprocket film guides not in closed position
Film does not take up in magazine	Film not engaged in take-up core; brake tension in camera weak; gears slipping (or binding) in magazine
Film scratch	Dirt in light trap of magazine; emulsion build-up on aperture plate; incorrect loop size

15.2 16mm MAURER 150 MAGAZINE (Fig. 15-5)

15.2a Type: Double-compartment.

15.2b Capacity: 400-ft and 1200-ft.

15.2c Lids: Two. Threaded.

To remove: Rotate counterclockwise.

15.2d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

15.2e Take-up

Right side. Film winds on spindle clockwise, emulsion always in.

15.2f Loading

1. Pull the magazine lockdown screw (between the compartments) *up* to clear the screw threads from magazine throat. Unscrew feed lid 2. In darkness, remove film roll from can and bag. Place the film roll flat on a surface above the magazine. Unwind, clockwise, approximately 18 in. of film. 3. Press the light-trap lock button at left of magazine throat to separate the feed rollers. Insert film end between the internal roller and compartment wall. Push through until film end exits the feed light trap. 4. Grasp film end and hold. Place film roll on the feed spindle. Rotate spindle wheel until the spindle pin engages the core keyway. 5. Replace feed lid. 6. Unscrew take-up lid in the light. Depress light-trap lock button at right of the magazine throat to separate take-up rollers. Insert film through light trap and between compartment wall and internal roller. 7. Insert film end in core and

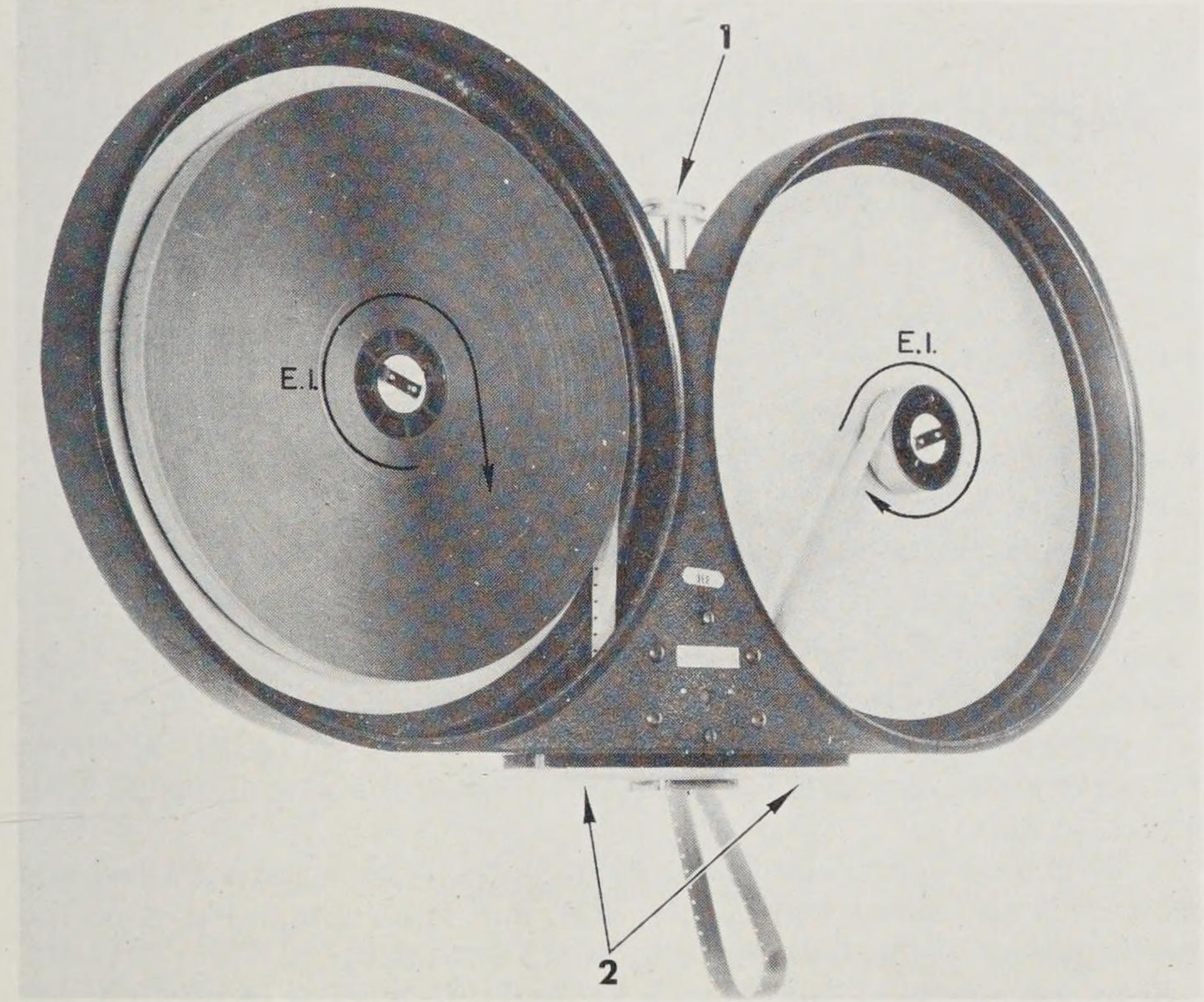


Fig. 15-5. Maurer 1200-ft magazine. Courtesy of J. A. Maurer, Inc.

1. Magazine lockdown screw
2. Light-trap lock buttons

wind on clockwise (emulsion in). Rotate spindle wheel until spindle pin engages take-up core keyway. 8. Replace take-up lid.

CAUTION: A small loop should be left outside the light traps so that when the magazine lockdown screw is pushed down (between the compartments) threads will not tear the film.

NOTE: Light traps open automatically when magazine is placed on camera.

To load daylight spools: Pull core holders from spindles (straight up). Place spools on square driver pins of spindles.

15.2g Unloading

In darkness, take up all slack. Unscrew take-up lid. Place middle finger on core and thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

15.2h Footage counter: None.

CHAPTER 16

Mitchell Cameras, Magazines, Blimps, and Accessories

16.1 MITCHELL 35mm STANDARD/HIGH-SPEED CAMERA* (Figs. 16-1, 16-2)

NOTE: All directions are from the Operator's point of view.

16.1a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lock-down screw. The base is L-shaped; includes turret (see Fig. 16-1). Flat section of base is fitted with dovetail tracks (gibs), allowing camera to slide (rack over) horizontally to align the focusing tube with the taking lens.

A dovetailed viewfinder bracket, into which the offset viewfinder is inserted, is also fitted with a filter slot, and is an integral part of the upright section of the base (see Fig. 16-42 for detail).

Four-way mattes: Used when a split-screen effect is to be achieved "in the camera." Adjustments permit any given size "framing" or division of the screen. Two double knobs (see Sec. 16.3, NC Camera) control the mattes, which are located behind the taking lens. The knobs rotate clockwise to move the mattes into the aperture. One double knob is located above the turret. The top half of this knob controls the bottom matte. The lower section of this knob controls the upper matte. The other double knob is located below the viewfinder bracket. The smaller half of this knob controls the right-side matte. The larger half of this knob controls the left-side matte.

WARNING: Since mattes can slip or be pushed and loosened, it is important to check the matte positions, prior to shooting and at each "hair check," to make certain they have not moved into the aperture and thus cut out a portion of film frame.

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*The manufacturer no longer uses the designation "Standard"; however, it is included here since there are so many "Standard" cameras still in use. While basically the same design, the immediately apparent differences between the "Standard" and "High Speed" are as follows: The "Standard" has two buttons at the back of the camera which actuate an automatic dissolve (see Sec. 16.1q); the "High Speed" has *no* automatic dissolve. The interior of a "High Speed" camera has a lower loop roller and a stabilizing roller (see Sec. 16.1m, Fig. 16-4) both of which "steady" the film in its rapid progress from feed to take-up side; the "Standard" does not have these two rollers.

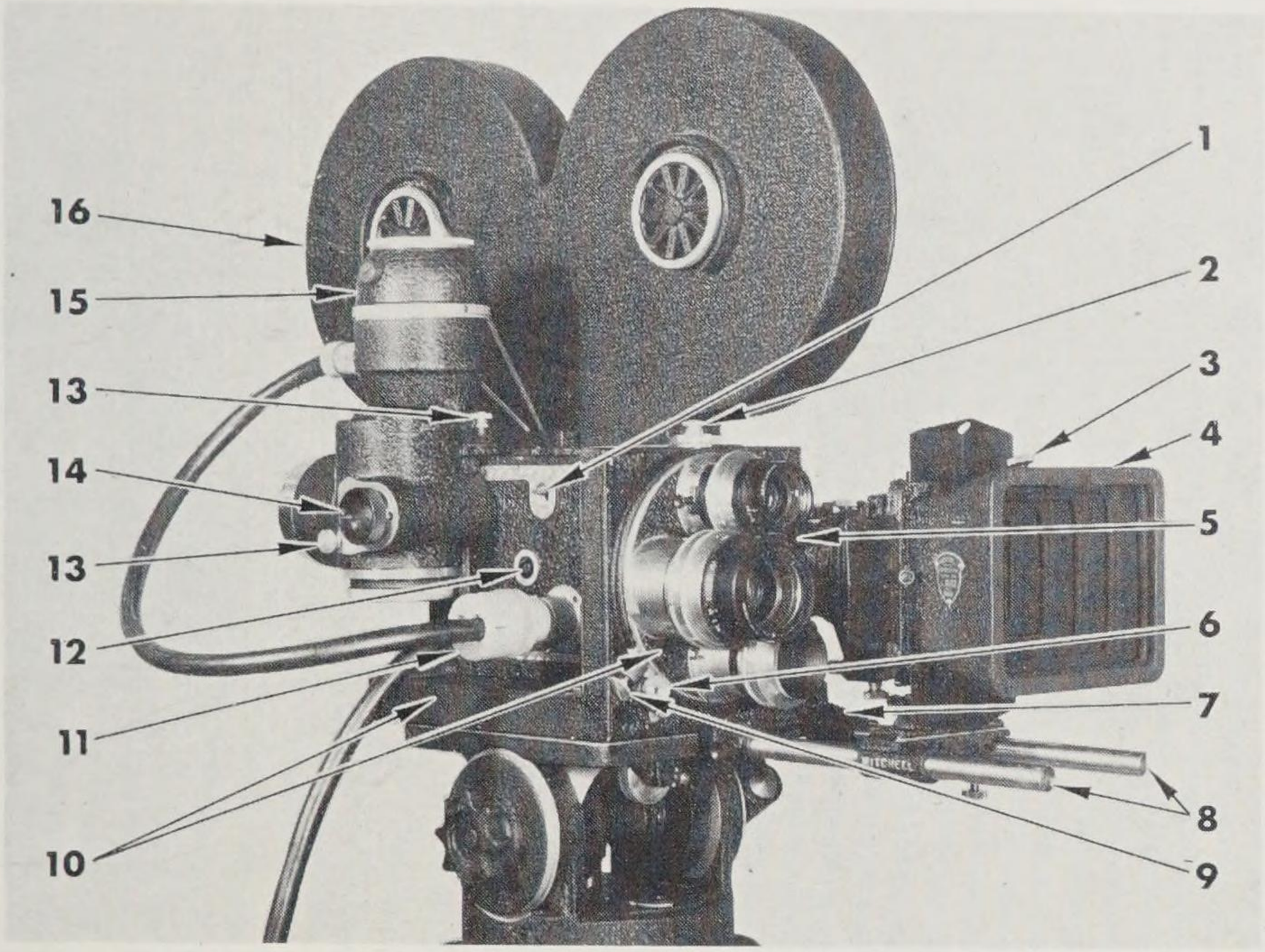

Fig. 16-1. Mitchell Standard/High-Speed with variable motor attached, and matte box in place (front view). Courtesy of Mitchell Camera Corp.

1. Motor door latch
2. Four-way matte knob
3. Extension shade screw
4. Sunshade/matte box
5. Taking lens (not visible)
6. Turret-setting knob
7. L-shaped matte-box bracket
8. Matte-box rods
9. Turret-locating pin
10. Base and turret
11. Power plug
12. Crank shaft
13. Motor lockdown screws
14. Manual motor-turning knob
15. Variable-speed motor (compare motor position to NC)
16. 1000-ft magazine

16.1b Rackover

Camera box must be racked over (i.e., moved laterally on gibs until focusing tube is directly behind taking lens) to sight through the taking lens.

To rack over:

1. Grasp handle at rear of camera (see Fig. 16-2) and depress button to release locating plunger. 2. Start to rotate handle clockwise and *release button immediately* so that the locating plunger can engage the camera box.

CAUTION: Some cameras are *not* equipped with stops to prevent excessive lateral movement of the camera box. Therefore, unless the button is released immediately, the camera can be racked completely off the base.

3. Rotate the handle, counterclockwise only, to check that plunger has engaged and that the focusing tube is aligned with the taking lens.

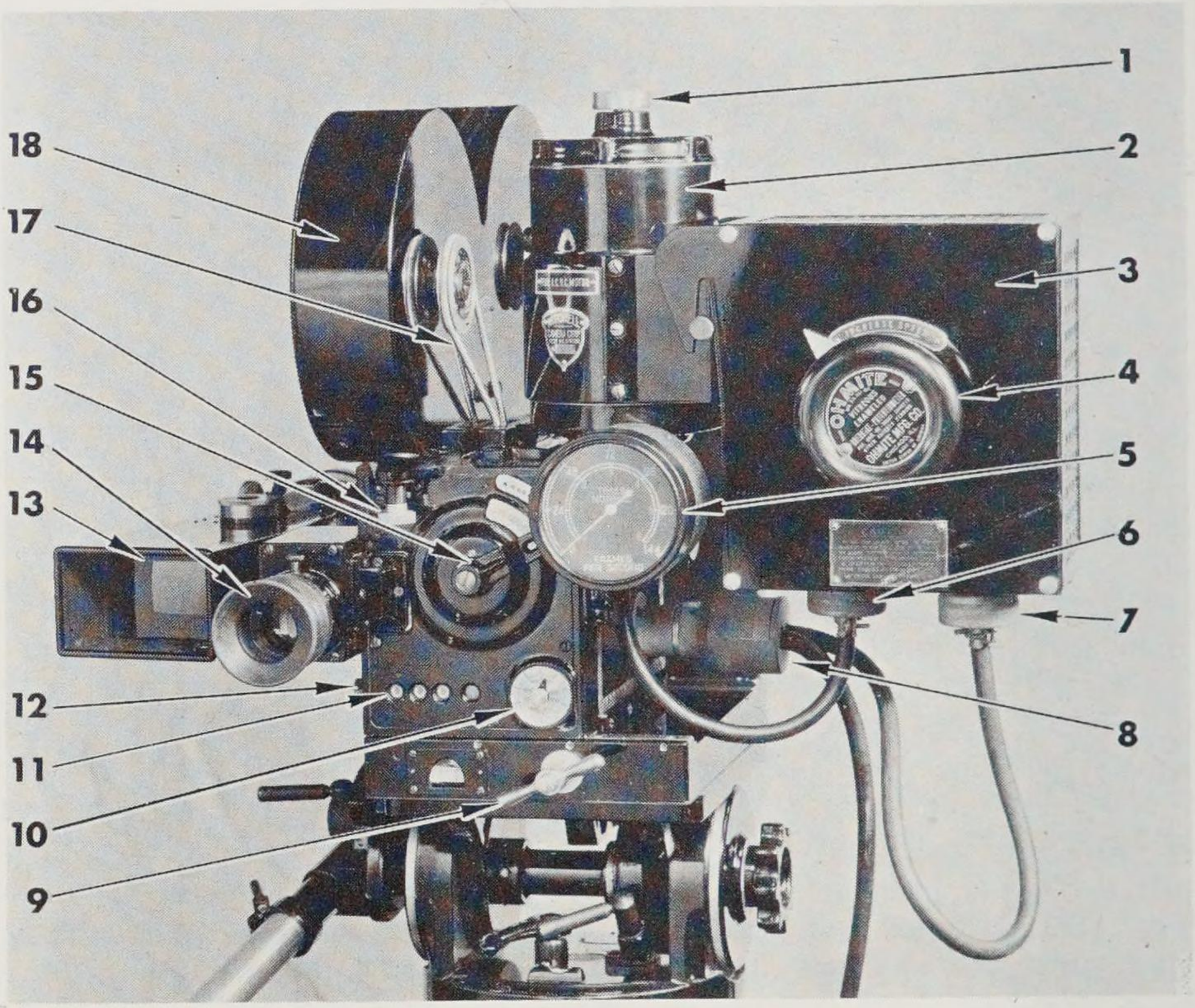

Fig. 16-2. Mitchell Standard/High-Speed with high-speed motor attached (rear view). Courtesy of Mitchell Camera Corp.

1. Manual motor-turning knob
2. High-speed motor
3. Rheostat
4. Rheostat knob
5. Tachometer
6. Motor twistlock male extension plug
7. Power-line extension
8. Power-line plug
9. Rackover handle
10. Dial counter
11. Footage and frame counters
12. Counter reset knob
13. Offset viewfinder
14. Focusing tube eyepiece
15. Shutter handle
16. Magazine lockdown knob
17. Take-up belt
18. 400-ft magazine

CAUTION: Since the camera will run racked over unless fitted with an automatic cutout switch, the camera must be racked back *before* shooting commences.

To rack back:

1. Depress button and start to rotate handle counterclockwise. *Release button immediately* so that the locating plunger can engage the camera box. 2. Rotate handle clockwise to check that locating plunger has engaged the camera box and that the aperture is aligned with the taking lens.

16.1c Focusing tube: Located in camera box dóor (see Fig. 16-42).

To change or clean groundglass:

1. Slide access door (at side of focusing tube) toward Operator, open camera door, and insert eraser end of pencil into forward opening

of tube. 2. Slide groundglass sideways; grasp glass by edges and remove; clean and reinsert; close access door.

NOTE: *Always* insert groundglass with smooth surface toward rear of tube.

Matte slot: Located forward of the groundglass. Academy matte is inserted with the bent portion (used as a finger grip) pointed toward the Operator.

Effects matte: A frame of film cut with the Mitchell Matte Cutter (see Sec. 16.11d).

To insert effects matte: Remove the Academy matte from the focusing tube. Slide frame into matte slot upside down, perforations toward the access door.

Magnification: Push magnification knob (located below focusing tube) forward to magnify image 10×. Push back for normal image.

Contrast filters: Two. Knurled knob at top-rear flips green filter into view for orthochromatic film. Bottom-rear knob flips pan filter into view for panchromatic film.

Eyepiece: Rotates; moves in and out; adjusts to achieve focus on groundglass. Locking screw holds eyepiece at desired focus.

16.1d Motors (Fig. 16-3)

Before mounting motor to camera, make sure a motor door is mounted on the right side of the camera (see Fig. 16-1).

To mount motor door: Insert door in bottom retaining-lip of camera. Depress recessed latch in motor door; press door to camera. Release latch.

NOTE: (a) The upper left drive shaft in the door accepts the motor drive shaft and operates the camera at one frame per turn. (b) The center drive shaft in the door is for hand cranking or rewinding film manually and operates the camera at eight frames per turn. (Three turns per second equals sound speed, i.e., 24 fps.)

To mount variable-speed motor (Figs. 16-1, 16-3):

1. Align drive shafts of both door and motor. Lift the top motor lockdown screw *up* to slide motor against camera easily. (Manual motor-turning knob is at side of motor.) 2. Secure top and side motor lockdown screws to camera. 3. Insert six-pin Cannon plug of power line into motor-door receptacle. 4. Loop the wire and insert three-pin Cannon plug extension of the power line into the motor. (ON/OFF switch is in cable.) 5. Turn top of motor clockwise for "forward," counterclockwise for "reverse." 6. Adjust camera speed by turning rheostat at bottom of motor.

NOTE: (a) The frame-per-second scribes (8–24 fps) on the rheostat are approximate. Correct speed is obtained by observing the tachometer and adjusting the rheostat. (b) Tachometer registers 0–32 fps in increments of two frames per second and 0–120 ft/min in increments of two feet per minute.

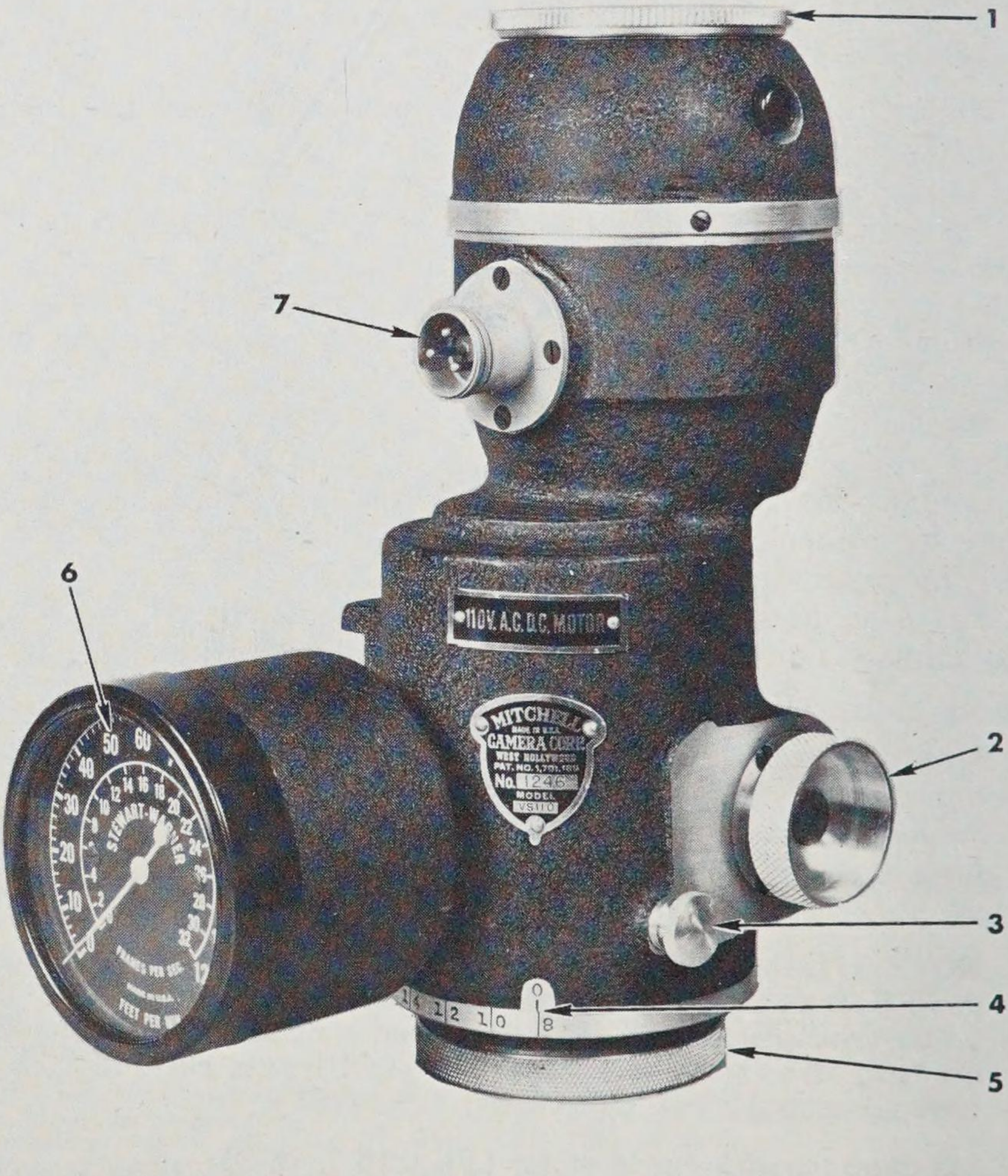

Fig. 16-3. Mitchell variable-speed (wild) motor. Courtesy of Mitchell Camera Corp.

1. FWD/REV switch
2. Manual motor-turning knob
3. Side motor lockdown screw knob
4. FPS scribe
5. Rheostat
6. Tachometer
7. Power-line extension plug

To reverse variable-speed motor:

Turn top of motor to "REV"; transfer belt from take-up to feed spindle wheel. Loop the belt into a "figure 8" to cause feed to act as "take-up"; adjust motor speed.

CAUTION: Cover lens or close shutter when running film back to beginning of scene intended for double exposure.

To mount high-speed motor (Fig. 16-2):

1. Align drive shafts of both camera door and motor. Lift the top motor lockdown screw *up* to slide motor against camera easily. (Manual motor-turning knob is at top of motor.) 2. Secure top and side motor lockdown screws to camera. 3. Slide inverted V-slots of the rheostat bracket over the motor rheostat mounting pins on the motor bracket. The rheostat knob should always face the Operator. 4. Insert six-pin Cannon plug of power line into motor door receptacle. 5. Insert both the female twist-lock extension of the power line and the male twist-lock extension of the motor into mating receptacles located at the bottom of the rheostat. Set rheostat knob to zero.

To adjust motor speed: Turn rheostat knob clockwise while observing tachometer.

CAUTION: Never start the camera at any speed faster than 24 fps. Starting at a higher speed will tear the film perforations. The best method is to start the camera with rheostat knob at zero and crank it up *slowly!*

WARNING: The rheostat must be zeroed, i.e., turned counterclockwise, to slow down the camera before turning the power-line switch OFF. Slowing down the camera via the rheostat acts as a "brake" on the film roll. If the camera is stopped abruptly, centrifugal force will cause the film roll to continue unraveling and pile up inside the *camera.*

CAUTION: A magazine brake should be installed on the feed spindle wheel to slow down and prevent the film roll in the feed compartment from unraveling and piling up inside the *magazine.*

NOTE: The high-speed motor tachometer registers 0–144 fps in increments of 24 frames per second. Digits on the face of the tachometer numbered 1–6 indicate "times normal" speed (e.g., 24 fps = normal, or "1" on the tachometer; 48 fps = "2" on the tachometer; 72 fps = "3" on the tachometer, etc.).

The following motors are available for the Mitchell Standard/High Speed:

Variable-speed motor: 12V DC; 110V AC/DC (60 Hz); 110V AC/DC (50 Hz).

Slow motion motor: 110V AC/DC (60 Hz) (24–128 fps); 110V AC/DC (50 Hz) (24–128 fps).

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase); 220V AC (60 Hz) (3-phase); 220V AC (50 Hz) (3-phase); 220V AC interlock (3-phase).

Multi-duty motor: 220V AC (60 Hz) (3-phase)/96V DC.

NOTE: Multi-duty motor is only synchronous at 220V AC (60 Hz).

Animation motor: 110V AC (60 Hz); 110V AC (50 Hz).

16.1e Power line

Inserts into motor door and motor on variable-speed motor (see Fig. 16-1). On high-speed motor, insert the power line into the motor

door, then insert extensions of the power line and motor into the rheostat (see Fig. 16-2). ON/OFF switch of both units is in cable.

16.1f Turret: Four-position (see Sec. 16.3, Fig. 16-7).

To rotate: Pull out turret locating pin (lower right side), turn turret until desired lens is in position at right of viewfinder bracket. Release locating pin to lock turret.

NOTE: (a) Center turret-locking knob may be tightened to hold a heavy telephoto lens. Ideal tension on the turret for normal operation is obtained by tightening the knob by hand and then backing it off a quarter-turn. (b) The longest lens on the turret should be mounted opposite the shortest lens. (c) On some models, one port is fitted with "quick-set locks" (not shown), i.e., clamps which grasp the lens mount shoulder. These clamps are placed above and below the lens port and are loosened with a screwdriver. Quick-set locks permit efficient mounting and dismounting of a variety of lenses.

An easy method for mounting a lens using quick-set locks:

1. Rotate the turret until quick-set locks are at the top. Slide clamps aside horizontally, insert new lens mount (cut off portion of lens-mount shoulder aligns with perimeter of turret). 2. Slide the clamps back over the shoulder of the mount and tighten. 3. Rotate turret to place the lens in taking position.

NOTE: The lens *can* be mounted without rotating the turret. However, the upper quick-set lock drops down behind the lens-mount shoulder in this position, making it more difficult to slide the mount into the port. The safety of the lens must always be considered: the possibility of dropping the lens while "fighting" the top lock is increased if the turret is not rotated.

Turret setting knob: Adjacent to and below the turret locating pin. For normal operation the scribe line on the turret setting knob bracket must be aligned with the zero scribe line on the base. The turret setting knob is used to minimize distortion while photographing architecture at an angle. To achieve a rising and falling effect, as with a view camera, (equivalent to a 15° tilt of the tripod), loosen the turret setting knob and rotate the turret clockwise to lower front, counterclockwise to raise front. Tighten the setting knob and check focusing tube for any possible aperture cut-in on lens.

NOTE: (a) Rising- and falling-front effects are limited to static shots. (b) Effect is limited to lenses 35mm or longer.

CAUTION: Realign the scribe line on the turret setting knob bracket with the zero scribe line on the base immediately (see Fig. 16-7) upon completion of shot. Tighten the turret setting knob with a wrench to prevent slippage.

16.1g Lenses

To fit lens to turret:

1. Unscrew lens barrel from threaded Mitchell Mount. Align screw holes of mount with tapped holes in turret and secure with screws. 2. Insert lens barrel into threaded mount.

NOTE: (a) Rear elements of 18.5mm, 25mm, and 30mm lenses extend into camera aperture when seated; therefore, these lenses must be backed off to clear the aperture prior to rotating the turret. (b) Each mount is fitted with a focus lockdown screw.

16.1h Viewfinder

Offset (see Fig. 16-41). Fits and locks into dovetailed bracket (see Fig. 16-42) at left side of camera base.

Ribbon-matte–adjusting knobs: Located at top and left side of finder; scribed to indicate various focal-length settings: *wide-angle lenses* (25mm, 30mm, and 35mm) are scribed in red; *normal and long lenses* (40–100mm) are scribed in black; *152mm lens* scribed in red *and* black.

Knobs may be set to two different indicators: projector or TV. Top knob adjusts vertical ribbon mattes (frame sides). Side knob adjusts horizontal ribbon mattes (frame top and bottom).

When using a wide-angle lens, remove the threaded circular sunshade at the front of the finder and replace it with a reducer lens.

When using an 18.5mm lens the fields of the focusing tube, and that of the viewfinder with a reducer lens attached, must be compared visually so as to set the top and bottom frame lines in the viewfinder. Side lines will not match (the viewfinder cannot "see" as wide as the lens). The camera Operator must make allowance for the viewfinder cut-in and frame the scene accordingly.

Without the reducer lens, the full field of viewfinder approximates 35mm.

When using the 152mm red scribe, remove the circular sunshade at the front of the finder and replace it with an *enlarging lens.* The 152mm black scribe on the knob denotes the field without the enlarging lens.

NOTE: Some viewfinders are fitted with a slot tin the left viewfinder wall to accommodate plastic mattes for other than standard aspect ratios (see Sec. 16.11f).

Parallax adjustment:

To prepare viewfinder:

1. Screw the worm-gear–bushing bracket into bottom of finder.
2. Fit bushing into catch at side of the camera base (pressure latch holds the bushing in place).

To align vertical cross hair: Rotate worm-gear knob in bushing bracket until vertical cross hair in viewfinder matches reference point of cross hair in focusing tube. To hold the finder in place, secure the parallax lock knob, which is located between the focus lock knob and parallax throw-out lock knob at top front of finder (it rides in a restricted slot). This knob must be loosened each time parallax is to be corrected.

NOTE: A follow-focus unit with parallax correction cams is also available. (See Sec. 16.11b.)

To align horizontal cross hair (in finder—with horizontal cross hair in focusing tube):

1. Verify that viewfinder dovetail is properly seated in the camera base bracket before making *any* adjustments. Sight viewfinder cross hair on a horizontal reference point. Lock the camera down. 2. Loosen the turret setting knob (see Sec. 16.1f), and with the Operator's help, tilt turret until horizontal cross hair in focusing tube aligns with the horizontal reference point in the viewfinder. Compare top, bottom, and side clearances in finder and focusing tube. If satisfactory, tighten setting knob with wrench. If alignment is *not* possible, return the turret setting knob to zero. Operator will then have to make horizontal parallax correction as he composes his scenes.

Focus knob: The large knurled knob at left side of finder behind the prism. This knob causes the prism box to slide in and out on a shaft. The prism box is secured at the desired focus by a lock knob, directly above the shaft.

Pivot point: Viewfinder swings horizontally, full 90°, for access to camera door. To pivot finder, loosen the parallax throwout lock knob (at top front of finder and closest to the dovetail bracket) and release the worm-gear bushing from its pressure catch at the camera base. Push rear of finder away from the camera body.

16.1i Sunshade (see Fig. 16-1)

Bellows-type sunshade/matte box mounts on two rods that fit into an L-shaped bracket. The bracket is independent of the camera. A slotted female dovetail in the bracket slides on a dovetail mount at the side of the camera base. The bracket tightens with a screw. The front of the bracket is secured to the bottom front of the base with a knurled screw.

The sunshade/matte box is adjustable up and down; left and right; in and out. Top of the matte box is fitted with an extension-shade screw.

To verify clearance: Sight through the focusing tube, run forefinger around inner edge of matte-box opening—if tip of finger is visible, move entire unit toward lens. Repeat check until matte box is clear of lens.

A standard matte box allows for use of the 35mm lens if its bellows is fully collapsed; a wide-angle matte box is necessary for 25mm and 30mm lenses. The matte box must be removed entirely to use a lens wider than 25mm.

Lenses 50mm or longer may have to be removed from the turret in order to slide a wide-angle matte box back far enough to clear a wide-angle lens.

16.1j Filters

Gauze frames, matte holders, and a 3 × 3 in. filter holder are housed in the matte box. A pola-screen holder and a 2 × 2 in. filter holder are housed in the bellows. A wide-angle matte box houses three 3 × 3 in. filter holders and has no bellows.

Gelatine: Slot for internal filter is located in viewfinder bracket (see Fig. 16-42). When inserting filter holder the bent portion of the holder (used as a finger-grip) ALWAYS points toward the Operator. To check filter after insertion of holder, rack camera over, open the camera door, and expose the aperture opening in the upright section of the base. Determine visually that gelatine "covers" the aperture.

16.1k Door: Hinged at bottom.

To open: Depress catch in door; pull out and down.

To close: Lift up until flush with camera; pull focusing tube to verify that door is secure.

16.1l Magazines: 400-ft and 1000-ft (see Sec. 16-2, Fig. 16-6).

To mount:

1. Pull a loop from the magazine feed side. 2. Insert the magazine toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 3. Slide magazine forward and down until tapped hole in magazine heel aligns with the magazine lockdown screw (below the magazine plate). Rotate the magazine lockdown knob clockwise to tighten magazine to camera. Thread camera (see Sec. 16.1m).

To remove: Unthread film and break it. Place two fingers under the belt, pull laterally away from the magazine, rotate the fingers clockwise, and lift the belt from the spindle wheel groove. Disengage the magazine by rotating the lockdown knob counterclockwise and lift the magazine clear of the camera.

16.1m Threading (Fig. 16-4)

1. Press buckle-trip apron down and back to avoid accidental starting of camera during threading procedures (see Sec. 16.1n). Rotate upper and lower sprocket-guide rollers counterclockwise away from sprocket (on early models, rotate the sprocket-guide rollers clockwise). 2. Rotate manual turning knob on motor (see Fig. 16-3) until scribe on movement cam aligns to arrow (or zero line) on shuttle cam shaft —this retracts the registration pins from the aperture plate. 3. Loosen knurled and notched thumbscrew located below the pulldown claw. Push the pulldown claw arm down and back to clear claw from the aperture plate. Rotate and lock the thumbscrew to hold the claw in retracted position. 4. Raise upper and lower aperture-plate locks. Remove aperture plate by pulling *gently*. If plate does not slide easily, check to see whether pulldown claw and/or registration pins are clear of plate. 5. Clean plate. Make a special check of the pulldown claw and registration-pin holes for emulsion build-up or film chips. Replace plate. Depress aperture plate locks to secure. 6. Swing pressure-plate–spring arm clockwise and remove pressure plate from register plate. Clean, making sure rollers revolve freely. Replace pressure plate and spring arm. 7. Pull film from magazine feed side. Extend loop to lower front corner of camera (a rough guide for amount of film needed for threading).

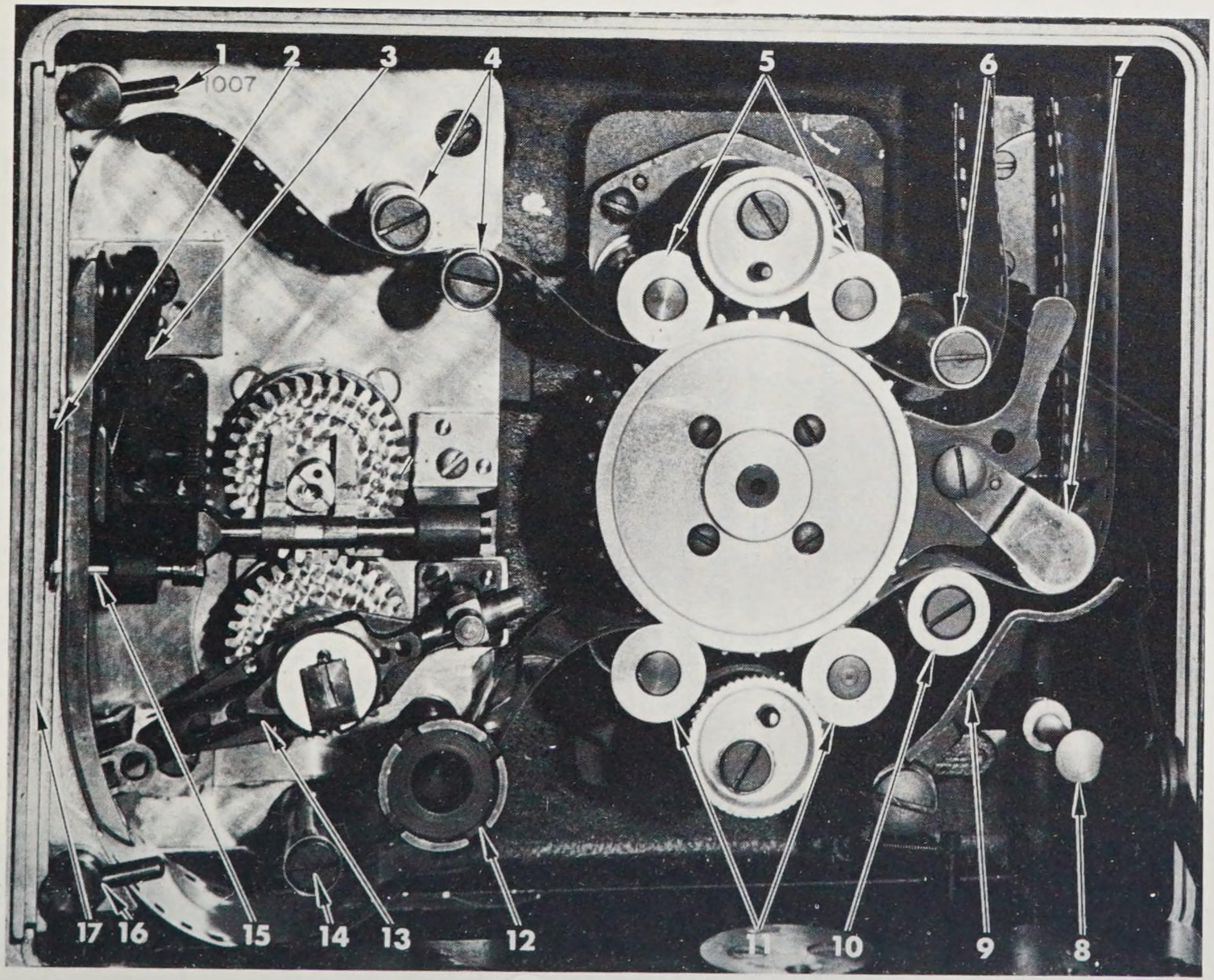

Fig. 16-4. Mitchell Standard/High-Speed threading detail. Courtesy of Mitchell Camera Corp.

1. Upper aperture plate lock
2. Matte slot
3. Pressure-plate lock
4. Twin rollers
5. Upper sprocket-guide rollers
6. Feed roller
7. Buckle-trip roller
8. Buckle-trip reset knob
9. Buckle-trip apron
10. Stabilizing roller (some models missing this roller)
11. Lower sprocket-guide rollers
12. Notched thumbscrew
13. Pulldown claw arm
14. Lower loop roller (some models missing this roller)
15. Registration pin (one of two)
16. Lower aperture plate lock
17. Aperture plate

Starting clockwise from the magazine take-up side, insert film: (a) Under buckle-trip roller and over stabilizing roller at right of lower sprocket-guide rollers, if the particular model has one. (b) Between sprocket and lower sprocket-guide rollers and under the thumbscrew, and under the lower loop roller (located below the pulldown claw), if the model has one; if not, proceed:

Starting counterclockwise from the magazine feed side, insert film: (a) Under the feed roller (directly below the magazine feed rollers); between sprocket and upper sprocket-guide rollers; over lower-right and under upper-left twin rollers. (b) In groove (the race) between the removable aperture plate and stationary register plate.

8. Hold film in race; loosen thumbscrew. The pulldown claw will spring forward. If claw touches film, raise or lower film in race until claw drops into perforation holes. Tighten thumbscrew finger-tight. 9. (a) Adjust lower loop so that when lower sprocket-guide rollers close, loop will clear bottom of camera interior by 1/8–1/4 in. at lowest arc of the loop. (b) Adjust upper loop so that when upper sprocket-guide rollers close, arc of loop aligns with top of the movement plate. 10. Rotate the magazine take-up spindle wheel clockwise to take up the film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel, and subjects the belt to a minimum of stretching). 11. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 12. 12. Pull buckle-trip reset knob (inside camera below buckle-trip apron); hold pins on upper and lower-sprocket guide rollers with thumb and forefinger.

CAUTION: Keep the knuckles of the hand clear of the movement!

Apply power in short bursts and observe action of film. If satisfactory, stop camera, close door, and reset footage counter.

16.1n Buckle-trip

Apron (a curved metal plate, see Fig. 16-4) located behind and below take-up side of the sprocket. The apron cuts out power automatically if film fails to take up when camera is running. Power should be deliberately cut out prior to threading (by tripping apron toward rear of camera) to prevent accidental starting of camera.

To reset: Pull buckle-trip reset knob below apron until unit snaps forward.

16.1o Footage and frame counters: Located at rear of camera above bubble level (see Fig. 16-2). Additive.

Footage counter: Registers each foot of film transported through camera up to 999 ft then reverts to zero and counts forward again. May be reset to zero each time magazine is changed; reset knob is located at left-rear side near camera door.

Frame counter: Additive in increments of one frame up to 16 frames, then back to one. Does not reset.

Dial counter: At rear of camera. Additive in increments of 20 ft up to 1000 ft, then reverts to zero. Reset in center of dial.

NOTE: The dial counter provides information regarding total footage exposed on a roll of film when the footage counter is reset to zero before all the film in the magazine is expended. This may occur when a specific length of a scene is needed (such as double exposure, special effects, etc.).

16.1p Tachometer: None on camera.

16.1q Shutter

Variable; 0°–170°. Calibrations and external control at back of camera (Fig. 16-2).

To change shutter opening:

1. Pull out and turn locking-pin knob in handle to move arm. When desired shutter opening appears at slot in shutter handle proceed to step 2. 2. Rotate knob until positive locking pin drops into place. Agitate handle to test engagement of pin.

To clear the shutter from the lens: Remove lens from lens mount. Observe shutter through lens port. Rotate manual motor turning knob until shutter clears camera aperture.

NOTE: Standard models may be fitted with automatic dissolve, high-speed models do not have this feature.

Automatic dissolve (not shown): Depress either of two buttons located at left of shutter arm lever to provide a 4-ft fade-in or fade-out while the camera is running. Depress OUT button (closes the shutter) to fade-out a scene. Depress IN button (opens the shutter) to fade-in a scene.

16.1r Lubrication (Fig .16-5)

Manufacturer recommends lubricating the following parts every 1000 ft of normal operation, with one or two drops of camera oil:

Eccentric (movement): Shuttle cam shaft, registration-pin pads, registration-pin arm (both sides of bracket); pulldown-claw arm (both sides of bracket), and the pulldown-arm bearing oil hole.

CAUTION: At high-speed operation the above parts should be oiled *before every run.*

Rollers: Every 10,000 ft, normal and high-speed.

Pressure-plate rollers: Every 10,000 ft, normal speed; every 1000 ft, high-speed.

NOTE: After oiling, run camera to eliminate excess oil and wipe camera interior.

16.1s Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-

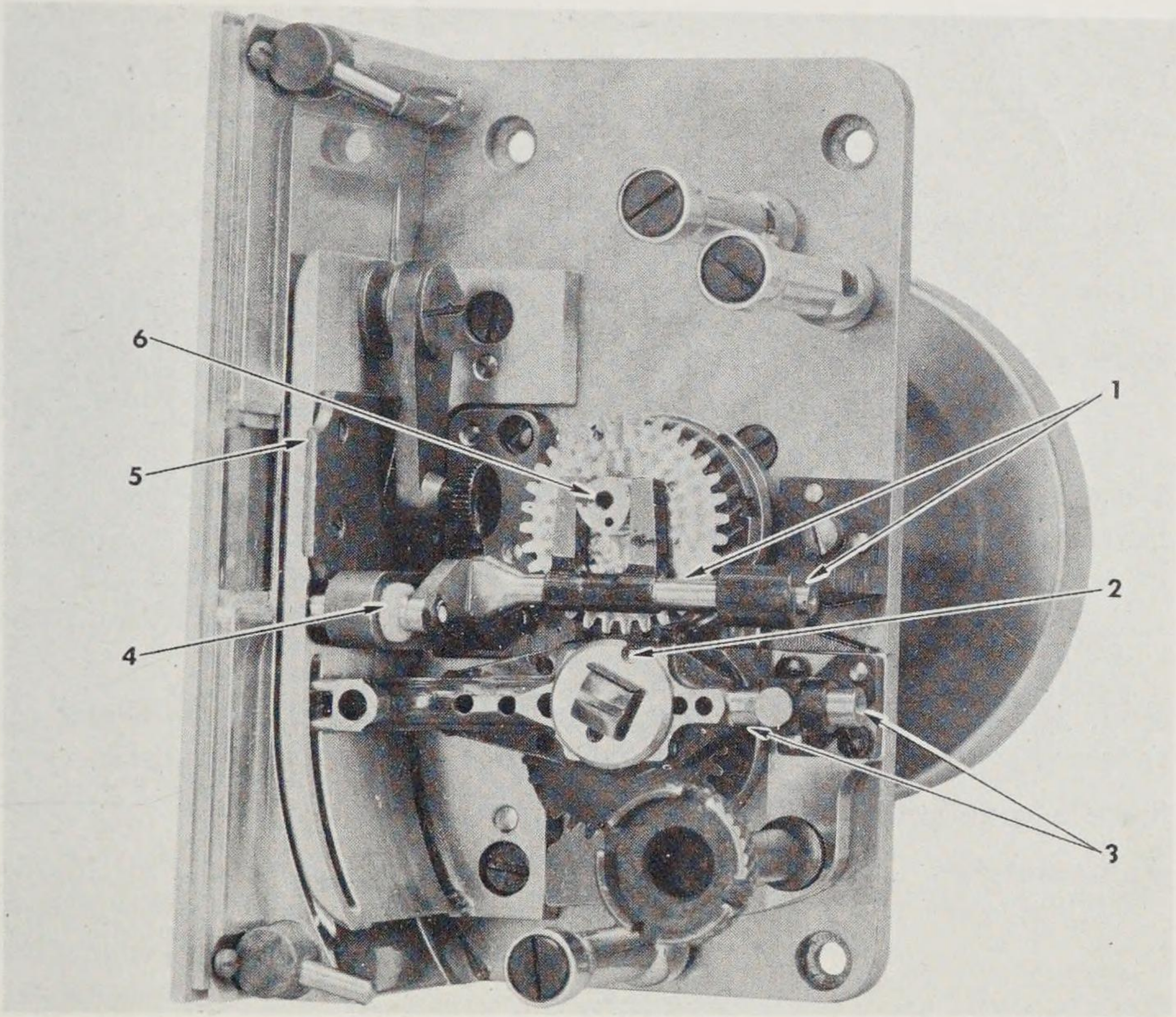

Fig. 16-5. Mitchell Standard/High-Speed lubrication. Courtesy of Mitchell Camera Corp.

1. Registration-pin arm (plunger arm)
2. Pulldown-arm bearing oil hole
3. Pulldown claw arm (swivel bearing)
4. Registration-pin pads (oilers)
5. Pressure-plate rollers
6. Shuttle cam shaft

up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

16.1t Weight: (With 1000-ft load) 70-1/2 lb.

16.1u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; camera racked over; power-line connection faulty; low temperature; FWD/REV switch at top of variable-speed motor in neutral position
Camera "hunts"	Camera not warmed up; voltage variation in power line

Trouble	*Probable Cause*
Camera door will not close	Sprocket-guide rollers not seated properly; interior thumbscrew not tightened; film chips or dirt in door
Film jam	Improper threading; take-up belt not on; magazine cover not relieved on "dished" roll
Lens will not focus	Lens not screwed all the way into mount; mount not seated properly; turret not seated properly; lens damaged
Viewfinder does not match focusing-tube cross hair	Camera not completely racked over; viewfinder not properly seated in dovetailed bracket; viewfinder parallax not set; turret not seated properly; wrong lens on front of viewfinder
Film will not slide into race	Registration pin or pulldown claw not retracted; emulsion or film chip in race
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up on the following: aperture plate, sprocket-guide rollers, pressure plate, registration pins; magazine rollers
Focusing tube blurred	Magnification knob seated between magnifying position (forward) and normal posion (back)
No take-up, or sporadic take-up	Belt slipping, or belt too loose
Cut-in on focusing tube	Internal filter holder not seated in filter slot; matte box extended; matte in focusing tube not seated; four-way mattes not wide open

16.2 MITCHELL 35mm NC, BNC, STANDARD/HIGH-SPEED, AND S35R MARK II MAGAZINE (Fig. 16-6)

16.2a Type: Double-compartment.

16.2b Capacity: 400-ft and 1000-ft (shown).

16.2c Lids: Two. Threaded.

To remove: rotate counterclockwise.

16.2d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

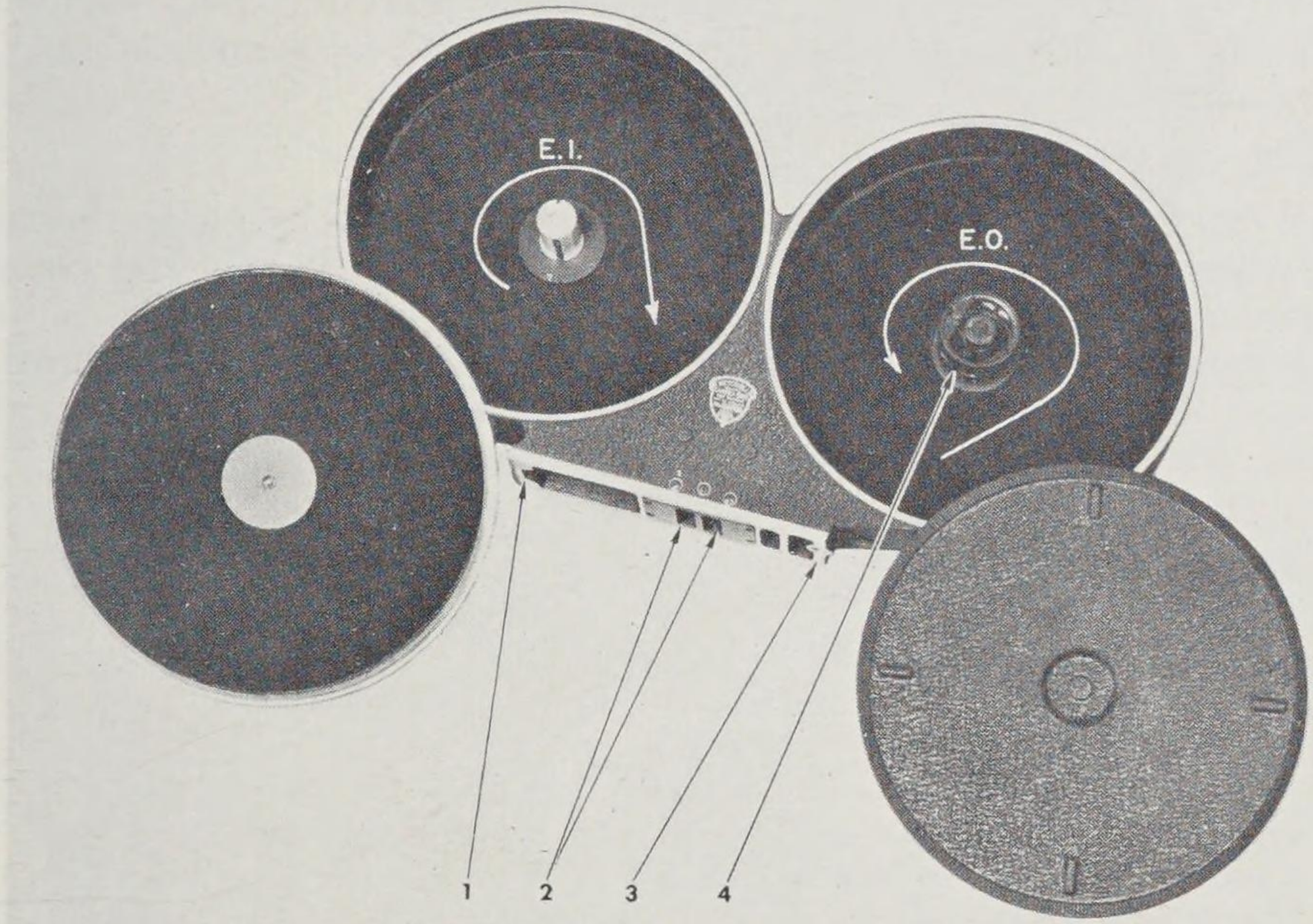

Fig. 16-6. Mitchell NC, BNC, Standard/High-Speed, S35R 1000-ft magazine. Courtesy of Mitchell Camera Corp.

1. Magazine toe
2. Light traps
3. Magazine heel
4. Metal core

16.2e Take-up

Right side. Film winds on spindle counterclockwise, emulsion always out.

16.2f Loading

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Insert the film end between the feed idler roller and magazine compartment wall (emulsion faces idler roller). 3. Push film through the feed-side light-trap rollers. 4. Place film roll on feed spindle. Rotate feed spindle until spindle pin engages the core keyway. 5. Replace feed lid. 6. Unscrew take-up lid in the light. 7. Insert the film end through the take-up–side light-trap rollers; push film end between the take-up idler roller (emulsion faces roller) and magazine compartment wall. 8a. When magazine has a *plastic core:* hold core on spindle pin; rotate take-up spindle wheel until spindle pin engages the core keyway. 8b. When magazine has a *metal core* (shown): hold core in hand; insert film end into core slot and pull center of core *up*, squeezing slot against film. 9a. When magazine has a *plastic core:* insert film end into core slot and wind film onto take-up spindle counterclockwise (emulsion side out). Replace take-up lid. 9b. When magazine has a *metal*

core: seat metal core in the "horns" of the grooved take-up spindle. Wind film onto take-up spindle counterclockwise (emulsion out). Replace lid.

16.2g Unloading: In darkness, unscrew take-up lid.

When magazine has a plastic core: Place index finger on core, thumb on edge of film roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

When magazine has a metal core: push center of metal core down, release film in core slot. Turn magazine over, remove film roll, and push core out.

> *CAUTION: Metal core stays with magazine!* Do not ship core with exposed film. Core is intended for reuse with each loading of magazine.

Place exposed roll in black bag and can.

16.2h Miscellaneous

NOTE: a. The NC and BNC 400-ft magazines, and the NC, BNC, and Mark II/S35R 1000-ft magazines are interchangeable (2-3/16 in. wide). The inverted Mark II/S35R 400-ft magazine is not interchangeable because it is gear driven. A magazine shim (called a "tuning fork" because of its shape) is required when using a Standard/High-Speed 400-ft or 1000-ft magazine (1-5/16 in. wide) on the NC, BNC, or Mark II/S35R. A *magazine shim* consists of two 1/8 × 1/8-in. metal bars joined by a thin flat bar at one end. The shim slides, flat bar *up*, into the camera magazine guide groove with the flat bar of the shim under the magazine toe catch. The open end of the shim must face the Operator. b. Mitchell magazine light-trap rollers are velvet covered, which necessitates constant checking for lint or dust. c. While spring tension on the outer rollers helps to keep the magazine lighttight, a light trap should be taped or covered with a black bag after each loading. d. Relieving the lid a quarter-turn eliminates "drag" and/or the scraping noise of a roll which may have "dished" in loading.

16.2i Footage counter: None on magazine.

16.3 MITCHELL 35mm NC CAMERA* (Figs. 16-7, 16-8)

NOTE: All directions are from the Operator's point of view.

16.3a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lock-down screw. The base is L-shaped; includes turret (see Fig. 16-7). Flat section of base is fitted with dovetail tracks (gibs), allowing camera to slide (rack over) horizontally to align the focusing tube with the taking lens.

A dovetailed viewfinder bracket, into which the offset viewfinder is inserted, is also fitted with a filter slot, and is an integral part of the upright section of the base (see Fig. 16-42 for detail).

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*Manufacturer states that the designation NC stands for "Newsreel Camera."

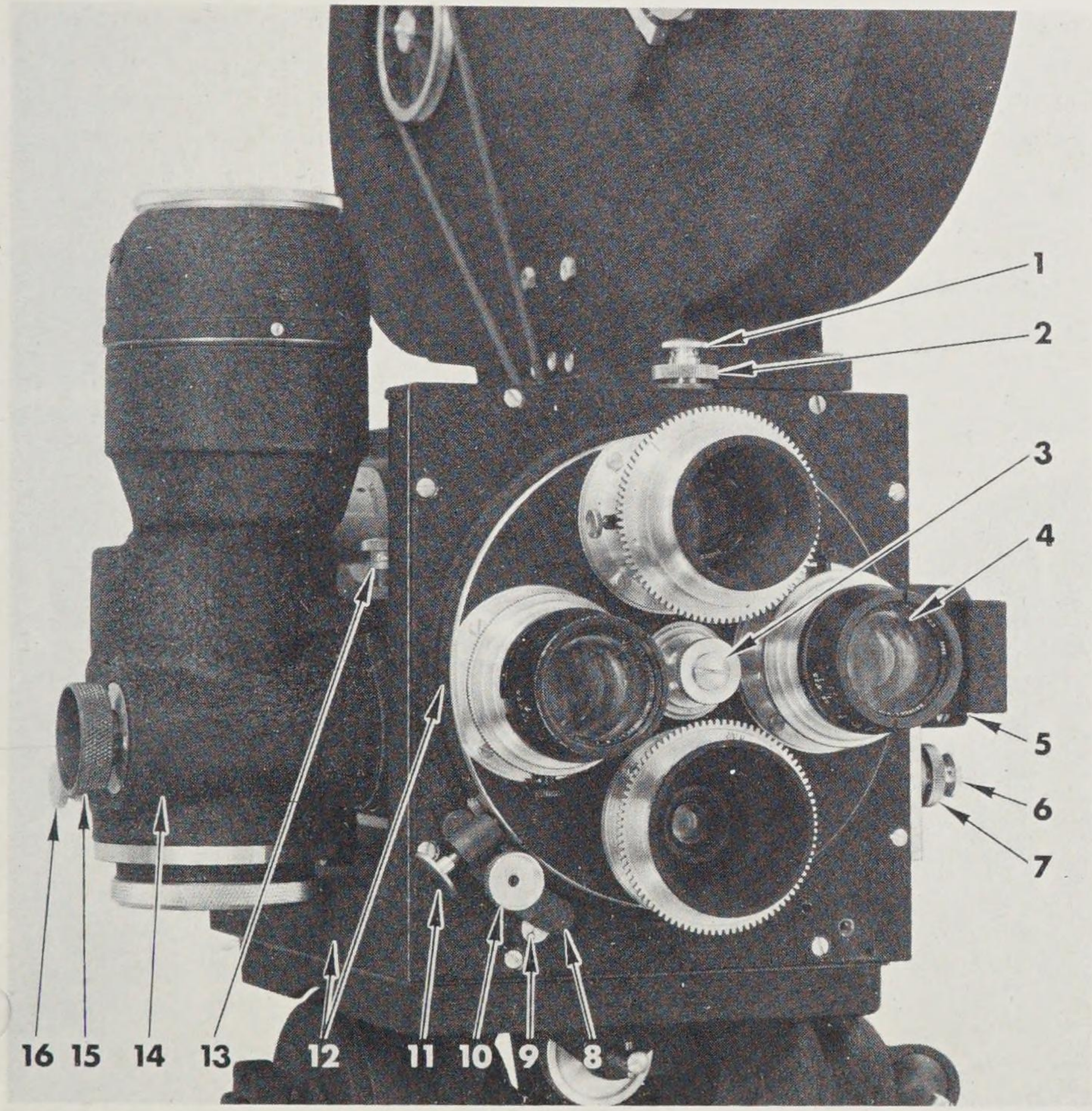


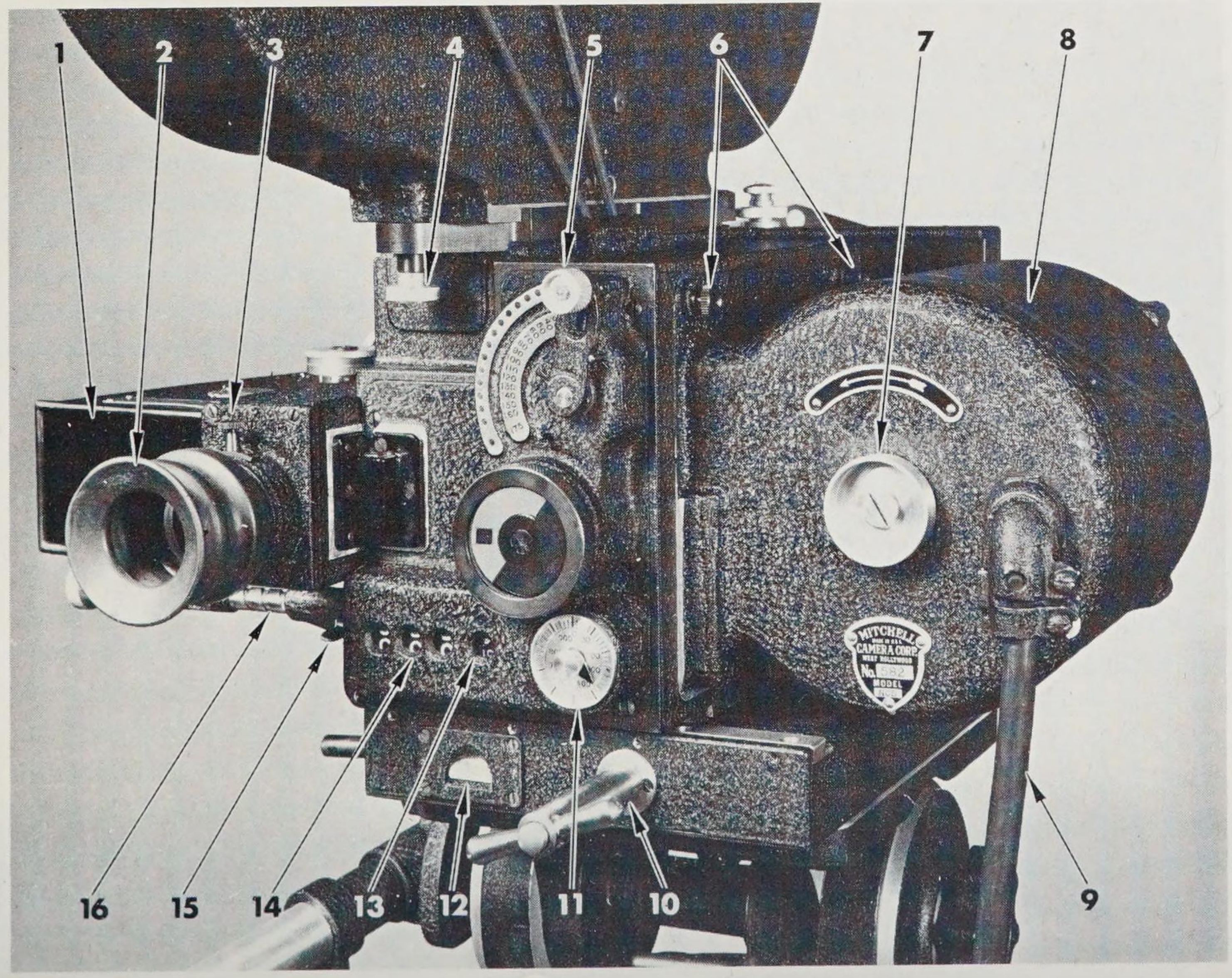
Fig. 16-7. Mitchell NC with variable-speed motor; matte box removed (front view). Courtesy of Mitchell Camera Corp.

1. Horizontal bottom-matte knob (of 4-way matte)
2. Horizontal top-matte knob (of 4-way matte)
3. Turret-lock knob
4. Taking lens
5. Viewfinder bracket
6. Right vertical matte knob (of 4-way matte)
7. Left vertical matte knob (of 4-way matte)
8. Turret-setting knob bracket
9. Turret-setting scribe lines
10. Rising/falling front adjust knob
11. Turret-locating pin
12. Base and turret
13. Top motor lockdown screw
14. Variable-speed motor (compare position of motor on NC door to Standard/High-Speed motor)
15. Manual motor-turning knob
16. Side motor lockdown screw

Four-way mattes (see Fig. 16-7): Used when a split-screen effect is to be achieved "in the camera." Adjustments permit any given size "framing" or division of the screen. Two double knobs (see Fig. 16-7) control the mattes, which are located behind the taking lens. The knobs rotate clockwise to move the mattes into the aperture. One

Fig. 16-8. Mitchell NC (sync motor attached; rear view). Courtesy of Mitchell Camera Corp.

1. Offset viewfinder
2. Focusing-tube eyepiece
3. Eyepiece locking screw
4. Magazine lockdown knob
5. Shutter handle knob
6. Motor mounting screws
7. Manual motor-turning knob
8. Sync motor
9. Power line
10. Rackover handle
11. Dial counter
12. Bubble level
13. Frame counter
14. Footage counter
15. Counter reset knob
16. Worm gear and bracket



double knob is located above the turret. The top half of this knob controls the bottom matte. The lower section of this knob controls the upper matte. The other double knob is located below the viewfinder bracket. The smaller half of this knob controls the right-side matte. The larger half of this knob controls the left-side matte.

WARNING: Since mattes can slip or be pushed and loosened, it is important to check the matte positions prior to shooting, and at each "hair check," to make certain they have not moved into the aperture thus cutting out a portion of film frame.

16.3b Rackover

Camera box must be racked over (i.e., moved laterally on gibs until focusing tube is directly behind taking lens) to sight through the taking lens.

To rack over:

1. Grasp handle at rear of camera (see Fig. 16-8) and depress button to release locating plunger. 2. Start to rotate handle clockwise and *release button immediately* so that the locating-plunger can engage the camera box.

CAUTION: Some cameras are *not* equipped with stops to prevent excessive lateral movement of the camera box. Therefore, unless the button is released immediately, the camera can be racked completely off the base.

3. Rotate handle only counterclockwise to check that plunger has engaged the camera box and that the focusing tube is aligned with the taking lens.

CAUTION: Since the camera will run racked over unless fitted with an automatic cutout switch, the camera must be racked back *before* shooting commences.

To rack back:

1. Depress button and start to rotate handle counterclockwise. *Release button immediately* so that the locating plunger can engage the camera box. 2. Rotate handle clockwise to check that locating plunger has engaged the camera box, and that the aperture is aligned with the taking lens.

16.3c Focusing tube: Located in camera box door (see Fig. 16-42.)

To change or clean groundglass:

1. Slide access door (at side of focusing tube) toward Operator, open camera door, and insert eraser end of pencil into forward opening of tube. 2. Slide groundglass sideways; grasp glass by edges and remove; clean and reinsert; close access door.

NOTE: *Always* insert groundglass with smooth surface toward rear of tube.

Matte slot: Located forward of the groundglass. Academy matte is inserted with the bent portion (used as a finger grip) pointed toward the Operator.

Effects matte: A frame of film cut with the Mitchell Matte Cutter (see Sec. 16.11d).

To insert effects matte: Remove the Academy matte from the focusing tube. Slide frame into matte slot upside down, perforations toward the access door.

Magnification: Push magnification knob (located below focusing tube) forward to magnify 10×; push back for normal image.

Contrast filters: Two. Knurled knob at top-rear flips green filter into view for orthochromatic film. Bottom-rear knob flips pan filter into view for panchromatic film.

Eyepiece: Rotates; moves in and out; adjusts to achieve focus on groundglass. Locking screw holds eyepiece at desired focus.

16.3d Motors

To mount synchronous motor (Fig. 16-8):

1. Rotate manual-turning knob (at rear of motor) until drive coupling aligns with movement drive shaft in camera. Press motor up against camera body. 2. Slide motor door latch at bottom, toward rear of camera. Secure the two knurled screws on the motor to tapped holes in the camera.

> NOTE: The NC and BNC synchronous motors are *not* interchangeable. An NC has a manual motor turning *knob* at the rear of the motor (Fig. 16-8); a BNC has a manual motor turning *gear* (not shown) at the rear of the motor. This motor gear accommodates the teeth of the internal gear within the BNC Motor Housing (see Sec. 16.4a and Sec. 16.4e). Also, a BNC motor is fitted with a 6-pin cannon plug in the motor which fits to a receptacle in the camera. The NC has *no* cannon plug in the motor or receptacle in the camera.

To mount variable-speed motor (Figs. 16-3 and 16-7): Requires NC motor door be mounted to the right side of the camera before mounting motor.

1. Fit motor door to camera, slide latch at bottom of camera toward the rear. Secure the two knurled screws to tapped holes. 2. Align drive shafts of both door and variable-speed motor at the protruding motor-drive housing. (Lift the top motor lockdown screw to slide motor easily onto housing.) Manual motor-turning knob is at side of motor. 3. Secure top and side motor lockdown screws to motor door housing. 4. Insert six-pin Cannon plug of power line into motor door receptacle. 5. Loop the wire and insert three-pin Cannon-plug extension of the power line into the motor. ON/OFF switch is in the cable. 6. Turn top of motor clockwise for "forward," counterclockwise for "reverse." 7. Adjust motor speed by turning rheostat at bottom of motor.

> NOTE: (a) The frame-per-second scribes (8–24 fps) on the rheostat are approximate. Correct speed is obtained by observing the tachometer and adjusting the rheostat. (b) Tachometer registers from 0–32 fps in increments of two frames per second and 0–120 ft/min in increments of two feet per minute.

To reverse variable-speed motor: Turn top of motor to "REV"; transfer belt from take-up to feed spindle wheel. Loop the belt into a "figure 8" to cause feed to act as "take-up"; adjust motor speed.

CAUTION: Cover lens or close shutter when running film back to beginning of scene intended for double exposure.

The following motors are available for the Mitchell NC:

Variable-speed motor: 12V DC; 110V AC/DC (60 Hz); 110V AC/DC (50 Hz).

Slow motion motor: 110V AC/DC (60 Hz) 24–128 fps; 110V AC/DC (50 Hz) 24–128 fps.

NOTE: Slow motion motor used on an NC requires a special motor door (see Sec. 16.3d).

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase); 220V AC (60 Hz) (3-phase); 220V AC (50 Hz) (3-phase); 220V AC interlock (3-phase).

Multi-duty motor: 220V AC (60 Hz) (3-phase)/96V DC.

NOTE: Multi-duty motor is only synchronous at 220V AC (60 Hz).

Animation motor: 110V AC (60 Hz); 110V AC (50 Hz).

16.3e Power line

Wired directly into sync motor (Fig. 16-8); ON/OFF switch in cable. Power line inserts into motor door and motor on variable-speed motor (Fig. 16-7).

16.3f Turret: Four-position (see Fig. 16-7).

To rotate: Pull out turret locating pin (lower right side), turn turret until desired lens is in position at right of viewfinder bracket. Release locating pin to lock turret.

NOTE: (a) Center turret-locking knob may be tightened to hold a heavy telephoto lens. Ideal tension on the turret for normal operation is obtained by tightening the knob by hand and backing it off a quarter-turn. (b) The longest lens on the turret should be mounted opposite the shortest lens. (c) On some models, one port is fitted with "quick-set locks" (not shown), i.e., clamps which grasp the lens mount shoulder. These clamps are placed above and below the lens port and are loosened with a screwdriver. Quick-set locks permit efficient mounting and dismounting of a variety of lenses.

An easy method for mounting a lens using quick-set locks:

1. Rotate the turret until quick-set locks are at the top: slide clamps aside horizontally, insert new lens mount (cutoff portion of lens mount shoulder aligns with perimeter of turret). 2. Slide clamps back over the shoulder of the mount and tighten. 3. Rotate turret to place the lens in taking position.

NOTE: The lens *can* be mounted without rotating the turret. However, the upper quick-set lock drops down behind the lens-mount shoulder in this position, making it more difficult to slide the mount into the port. The safety of the lens must always be considered: the

possibility of dropping the lens while "fighting" the top lock is increased if the turret is not rotated.

Turret setting knob: Adjacent to and below the turret locating pin. For normal operation the scribe line on the turret setting knob bracket must be aligned with the zero scribe line on the base. The turret setting knob is used to minimize distortion while photographing architecture at an angle. To achieve a rising and falling effect, as with a view camera, (equivalent to a 15° tilt of the tripod), loosen the turret setting knob and rotate the turret clockwise to lower front, counterclockwise to raise front. Tighten the setting knob, and check focusing tube for any possible aperture cut-in on lens.

NOTE: (a) Rising- and falling-front effects are limited to static shots. (b) Effect is limited to lenses 35mm or longer.

CAUTION: Realign the scribe line on the turret setting knob bracket with the zero scribe line on the base immediately (see Fig. 16-7) upon completion of shot. Tighten the turret setting knob with a wrench to prevent slippage.

16.3g Lenses

To fit lens to turret:

1. Unscrew lens barrel from threaded Mitchell Mount. Align screw holes of mount with tapped holes in turret, and secure with screws.
2. Insert lens barrel into threaded mount.

NOTE: (a) Rear elements of 18.5mm, 25mm, and 30mm lenses extend into camera aperture when seated; therefore these lenses must be backed off to clear the aperture prior to rotating the turret. (b) Each mount is fitted with a focus lockdown screw.

16.3h Viewfinder

Offset (see Fig. 16-41). Fits and locks into dovetailed bracket at left side of camera base (see Fig. 16-42).

Ribbon-matte–adjusting knobs: Located at top and left side of finder; scribed to indicate various focal-length settings: *Wide-angle lenses* (25mm, 30mm, and 35mm) are scribed in red. *Normal and long lenses* (40–100mm) are scribed in black. *152mm lens* scribed in red *and* black.

Knobs may be set to two different indicators: projector or TV. Top knob adjusts vertical ribbon mattes (frame sides). Side knob adjusts horizontal ribbon mattes (frame top and bottom).

When using a wide-angle lens, remove the threaded circular sunshade at the front of the finder and replace it with a *reducer lens.*

When using an 18.5mm lens the fields of the focusing tube, and that of the viewfinder with a reducer lens attached, must be compared visually so as to set the top and bottom frame lines in the viewfinder. Side lines will not match (the viewfinder cannot "see" as wide as the lens). The camera Operator must make allowance for the viewfinder cut-in and frame the scene accordingly.

Without the reducer lens, the full field of the viewfinder approximates 35mm.

When using the 152mm red scribe, remove the circular sunshade at the front of the finder and replace it with an *enlarging lens*. The 152mm black scribe on the knob denotes the field without the enlarging lens.

NOTE: Some viewfinders are fitted with a slot in the left (or top) finder wall to accommodate plastic mattes for other than standard aspect ratios, but these are modifications of the manufacturer's product. (See Sec. 16.11f.)

Parallax adjustment:

To prepare viewfinder:

1. Screw the worm-gear–bushing bracket into bottom of finder. 2. Fit bushing into catch at side of the camera base (pressure latch holds the bushing in place).

To align vertical cross hair: Rotate worm-gear knob in bushing bracket until vertical cross hair in viewfinder matches reference point of cross hair in focusing tube. To hold the finder in place, secure the parallax lock knob, which is positioned in the horizontal restricted slot between the focus lock knob and the parallax throw-out lock knob at top front of finder (it rides in a restricted slot). This knob must be loosened each time parallax is to be corrected.

NOTE: A follow-focus unit with parallax correction cams is also available. (See Sec. 16.11b.)

To align horizontal cross hair (in finder—with horizontal cross hair in focusing tube):

1. Verify that viewfinder dovetail is properly seated in the camera base bracket before making *any* adjustments. Sight viewfinder cross hair on a horizontal reference point. Lock the camera down. 2. Loosen the turret setting knob (see Sec. 16.3f), and with the Operator's help, tilt turret until the horizontal cross hair in focusing tube aligns with the horizontal reference point in the viewfinder. Compare top, bottom, and side clearances in finder and focusing tube. If satisfactory, tighten setting knob with wrench. If alignment is *not* possible, return the turret setting knob to zero. Operator will then have to make horizontal parallax corrections as he composes his scenes.

Focus knob: The large knurled knob at left side of finder behind the prism box. This knob causes the prism box to slide in and out on a shaft. The prism box is secured at the desired focus by a lock knob, directly above the shaft.

Pivot point: Viewfinder swings horizontally, full 90°, for access to camera door. To pivot finder, loosen the parallax throwout lock knob (at top front of finder and closest to the dovetail bracket) and release the worm-gear bushing from its pressure catch at the camera base. Push rear of the finder away from the camera body.

16.3i Sunshade (see Fig. 16-1)

Bellows-type sunshade/matte box mounts on two rods that fit into an L-shaped bracket. The bracket is independent of the camera. A

slotted female dovetail in the bracket slides on a dovetailed mount at the side of the camera base. Bracket tightens with a screw. The front of the bracket secures to the bottom front of the base with a knurled screw.

The sunshade/matte box is adjustable up and down; left and right; in and out. Top of the matte box is fitted with an extension shade screw.

To verify clearance: Sight through the focusing tube, run forefinger around inner edge of matte box opening—if tip of finger is visible, move entire unit toward lens. Repeat check until matte box is clear of lens.

A standard matte box allows use of the 35mm lens if its bellows is fully collapsed; a wide-angle matte box is necessary for 25mm and 30mm lenses. The matte box must be removed entirely to use a lens wider than 25mm.

Lenses 50mm or longer may have to be removed from the turret in order to slide a wide-angle matte box back far enough to clear a wide-angle lens.

16.3j Filters

Gauze frames, matte holders, and a 3 × 3 in. filter holder are housed in the matte box. A pola-screen holder and a 2 × 2 in. filter holder are housed in the bellows. A wide-angle matte box houses three 3 × 3 in. filter holders and has no bellows.

Gelatine: Slot for internal filter is located in viewfinder bracket (see Fig. 16-42). When inserting filter holder the bent portion of the holder (used as a finger-grip) ALWAYS points toward the Operator. To check filter after insertion of holder, rack camera over, open the camera door, and expose the aperture opening in the upright section of the base. Determine visually that gelatine "covers" the aperture.

16.3k Door: Hinged at bottom.

To open: Depress catch in door; pull out and down.

To close: Lift up until flush with camera; pull focusing tube to verify that door is secure.

16.3l Magazines: 400-ft and 1000-ft (see Fig. 16-6).

To mount:

1. Pull a loop from the feed side. 2. Insert the toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 3. Slide magazine forward and down until tapped hole in heel aligns with the magazine lockdown screw. Rotate the magazine lockdown knob clockwise to tighten magazine to camera. Thread camera (see Sec. 16.3m).

To remove magazine: Unthread film and break it. Place two fingers under the belt, pull laterally away from the magazine, rotate fingers clockwise, and lift the belt from the spindle wheel grooves. Disengage the magazine by rotating the lockdown knob counterclockwise and lift the magazine clear of the camera.

16.3m Threading (Fig. 16-9)

1. Press buckle-trip apron toward rear of camera to avoid accidental

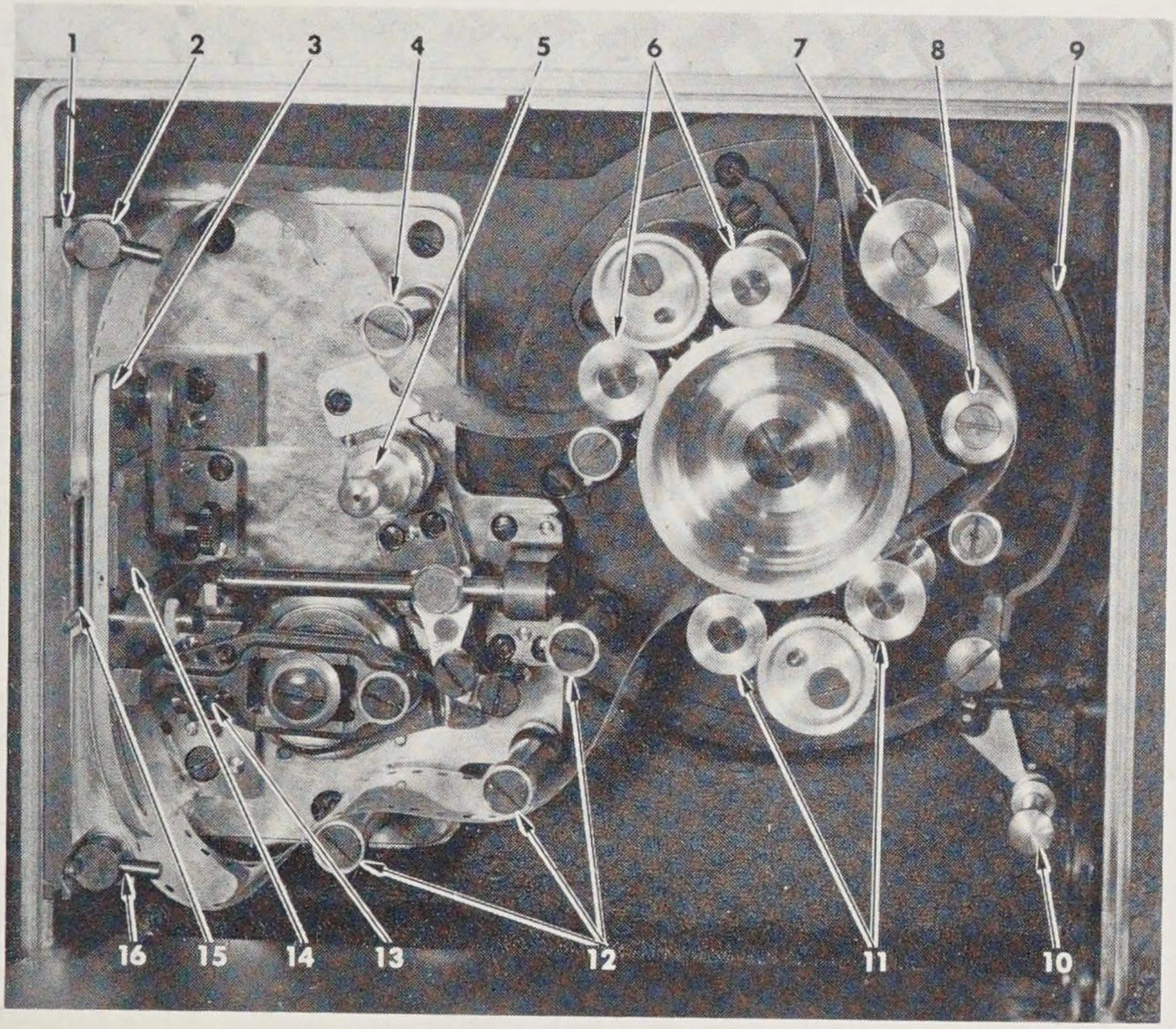


Fig. 16-9. NC threading. Courtesy of Mitchell Camera Corp.

1. Aperture plate
2. Upper aperture plate lock
3. Register plate
4. Roller
5. Registration-pin throw-out knob
6. Upper sprocket-guide rollers
7. Take-up roller
8. Buckle-trip roller
9. Buckle-trip apron
10. Buckle-trip reset knob
11. Lower sprocket-guide rollers
12. Rollers
13. Pulldown claw
14. Pressure plate
15. Matte slot
16. Lower aperture plate lock

starting of camera during threading procedures (see Sec. 16.3n). Rotate upper and lower sprocket-guide rollers counterclockwise away from the sprocket (on early models, rotate the sprocket-guide rollers clockwise). 2. Rotate manual turning knob on motor (see Figs. 16-7, 16-8) until pulldown claw retracts from the register plate (a back and upward stroke). Pull the registration-pin throw-out knob and move it toward the rear of the camera. 3. Raise upper and lower aperture-plate locks, remove aperture plate by pulling *gently*. If plate does not slide easily, check to see that pulldown claw and/or registration pins are clear of plate. 4. Clean plate. Make a special check of the pulldown claw and registration-pin holes for emulsion build-up or film chips; replace plate. Depress aperture-plate locks to secure. 5. Swing

pressure-plate spring arm clockwise. Remove pressure plate from register plate. Clean and make sure rollers revolve freely. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to lower front corner of camera (a rough guide for amount of film needed for threading).

Starting clockwise from the magazine take-up side, insert film: (a) Under large take-up film roller nearest to the magazine take-up rollers, then to right of buckle-trip roller. (b) Then to left of small roller, and between the lower sprocket-guide rollers and sprocket. (c) *Under* small lower roller at left of sprocket-guide rollers, and *over* small roller below pulldown claw eccentric.

Starting counterclockwise from the magazine feed side, insert film: (a) Between upper sprocket-guide rollers, and *under* small roller above registration-pin throwout knob. (b) Then in groove (the race) between the removable aperture plate and stationary register plate.

7. Hold film in race, pull registration-pin throw-out knob and move it toward the aperture plate *gently* to determine whether registration pins are entering the film perforations. If pins touch film, raise or lower the film in the race, while moving the throwout knob back and forth until the pins engage the perforations. 8. (a) Adjust lower loop so that when the lower sprocket-guide roller closes, the loop will clear the bottom of camera interior by 1/8–1/4 in. at lowest arc of the loop. (b) Adjust upper loop so that when the upper sprocket-guide roller closes, top of the loop aligns with the top of the movement plate. 9. Rotate the magazine take-up spindle wheel clockwise to take up film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel, and subjects the belt to a minimum of stretching). 10. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 11. 11. Pull buckle-trip reset knob (inside camera below buckle-trip apron); hold pins on upper and lower sprocket-guide rollers with thumb and forefinger.

CAUTION: Keep the knuckles of the hand clear of the movement!

Apply power in short bursts and observe action of film. If satisfactory, stop camera, close door, and reset footage counter.

16.3n Buckle-trip

Apron (a curved metal plate) located behind take-up side of the sprocket (see Fig. 16-9). The apron cuts out power automatically if film fails to take up when camera is running. Power should be deliberately cut out prior to threading (by tripping apron toward rear of camera) to prevent accidental starting of camera.

To reset: Pull buckle-trip reset knob below apron until unit snaps forward.

16.3o Footage and frame counters

Located at back of camera above bubble level (see Fig. 16-8).

Footage counter: Additive. Registers each foot of film transported through camera up to 999 ft, then reverts to zero and counts forward again. May be reset to zero each time magazine is changed; reset knob is located at left-rear side near camera door.

Frame counter: Addiitve in increments of one frame up to 16 frames, then back to one. Does not reset.

Dial counter: At rear of camera below miniature shutter. Additive in increments of 20 ft up to 1000 ft, then reverts to zero. Reset knob in center of dial.

NOTE: The dial counter provides total footage count exposed on a roll of film when the footage counter is reset to zero before all the film in the magazine is expended. This occurs when a specific length of a scene is needed (such as double exposure, special effect, etc.).

16.3p Tachometer: None on camera.

16.3q Shutter

Variable; 0–175°. Calibrations and external control at back of camera (Fig. 16-8).

To change shutter opening:

1. Pull out and turn locking-pin knob in handle to move arm. When desired shutter opening appears at slot in shutter handle, proceed to step 2. 2. Rotate knob until positive locking pin drops into place. Agitate handle to test engagement of pin.

Miniature shutter: At rear of camera. Circular dial is scribed with a miniature aperture, which provides an easy visual check of the shutter opening and its position in relation to the camera aperture. The black area of the dial conforms to adjustments made to the camera shutter. The white area of the dial denotes the degrees of shutter opening. The miniature shutter rotates in synchronization with the camera shutter.

To clear the shutter from the lens: Rotate manual motor-turning knob (see Figs. 16-7, 16-8) until the white area of the miniature shutter fills the miniature-aperture scribe.

16.3r Lubrication (Fig. 16-10)

Manufacturer recommends lubricating the following parts every 2000 ft with one or two drops of camera oil:

Eccentric (movement): Registration-pin pads, plunger arm, and bracket (both sides), sliding block, rear bearing, sliding-block bearing of pulldown claw, eccentric-arm bearing, and timing-block unit.

Rollers: Every 10,000 ft, except for the large take-up roller and buckle-trip roller, which should be lubricated every 3000 ft.

Pressure-plate rollers: Every 10,000 ft.

NOTE: After oiling, run camera to eliminate excess oil and wipe interior.

16.3s Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

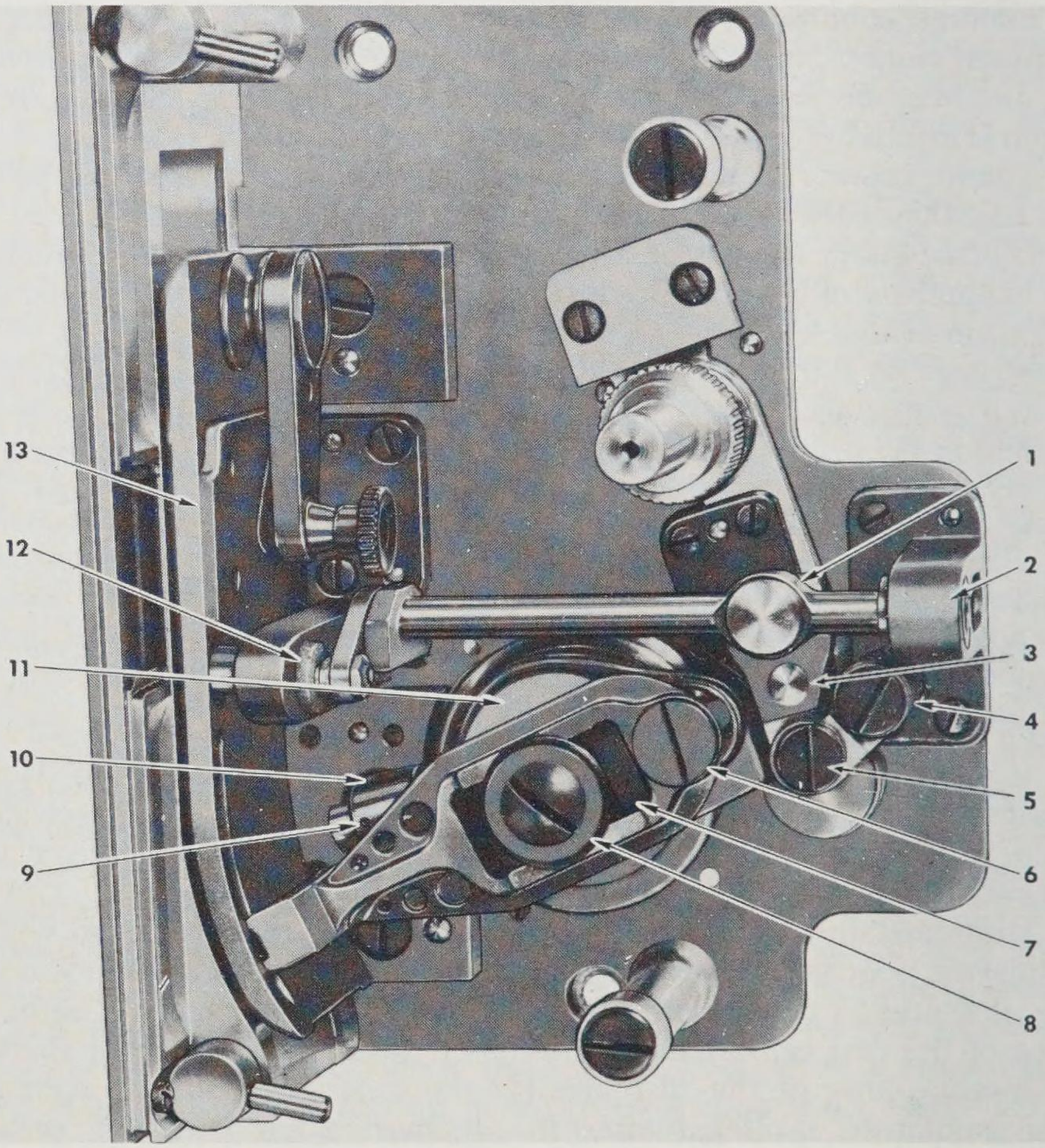


Fig. 16-10. Mitchell NC eccentric lubrication. Courtesy of Mitchell Camera Corp.

1. Swivel block
1. Plunger-arm bracket
3. Pivot-arm bearing
4. Toggle arm rear bearing
5. Toggle arm rear bearing
6. Pull-down claw rear bearing
7. Sliding block
8. Sliding-block bearing
9. Eccentric-arm bearing
10. Timing-block unit
11. Eccentric-arm bearing
12. Registration-pin pads (oilers)
13. Pressure-plate rollers (not visible)

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

16.3t Weight: (with 1000-ft load) 70-1/2 lb.

16.3u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; camera racked over; Power-line connection faulty; low temperature; when using variable-speed motor: FWD/REV switch at top of motor in neutral position
Camera "hunts"	Camera not warmed up; voltage variation in power line
Camera door will not close	Sprocket-guide rollers not seated properly; registration-pin throw-out knob not forward; film chip or dirt in door
Film jam	Improper threading; take-up belt not on; magazine cover not relieved on "dished" roll
Lens will not focus	Lens not screwed all the way into mount; mount not seated properly; turret not seated properly; lens damaged
Viewfinder does not match focusing-tube cross hair	Camera not completely racked over; viewfinder not properly seated in dovetail bracket; viewfinder parallax not set; turret not seated properly; wrong lens on front of viewfinder
Film will not slide into race	Registration pin or pulldown claw not retracted; emulsion or film chip in race
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up on the following: aperture plate, sprocket-guide rollers, pressure plate, registration pins; magazine rollers
Focusing tube blurred	Magnification knob seated between magnifying position (forward) and normal position (back)
No take-up, or sporadic take-up	Belt slipping, or belt too loose
Cut-in on focusing tube	Internal filter holder not seated in filter slot; matte box extended; matte in focusing tube not seated; four-way mattes not wide open

16.3v NC magazine-loading instructions: See Sec. 16.2.

16.4 MITCHELL 35mm BNC CAMERA* (Figs. 16-11, 16-12)

NOTE: All directions are from the Operator's point of view.

16.4a Outer case

Consists of three sound-insulated sections: (1) main housing; (2) motor housing; (3) magazine housing.

Main housing: Fitted with ⅜"-16 tapped hole on bottom. A modified NC camera and base are permanently installed within the main housing.

Access to camera: Squeeze main housing door handles together, pull out and down.

Motor housing: Attaches to the right side of main housing, and covers motor.

NOTE: A manual motor-turning wheel is at the back of the housing (see Fig. 16-12). This spring-loaded wheel is connected by a shaft to a gear inside the housing and is used for engaging the manual motor-turning gear of the BNC synchronous motor (see Sec. 16.4e).

To install: Slide bottom lip of motor housing into two upright supports in base of main housing. Secure the two knurled screws at top of motor housing to tapped holes in main housing.

To engage manual motor-turning gear on motor: Push in the spring-loaded wheel at rear of motor housing (see Fig. 16-12).

Magazine housing: Must be mounted on main housing *before* magazine is installed on camera.

To install:

1. Slide locating flange (the toe) of the magazine housing under the front hold-down bar (lip) of the main housing. 2. Insert rear magazine-housing lock into hold-down bracket on main housing. To lock: turn handle.

Access to magazine: Push access door lock (at rear) *up*. Swing magazine-access door forward and engage door stud into catch at front of housing.

NOTE: Some catches may be worn and fail to hold the door. Tilting the camera down slightly will prevent the door from closing and thus facilitate the loading operation.

Latched viewing ports at right side provide access to the magazine spindle wheels and belt. The front porthole can be fitted with a "tattletale": a bent paper clip that engages the magazine feed spindle and makes a pinging noise if the camera is run in the racked over position. This is not a standard installation, but a device most crews will install themselves.

NOTE: Some BNC's may have a microswitch (not shown) installed in the camera to prevent operation when the camera is in the rack-over position, but which provides no warning sound.

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*Manufacturer states the designation BNC stands for "Blimped Newsreel Camera."

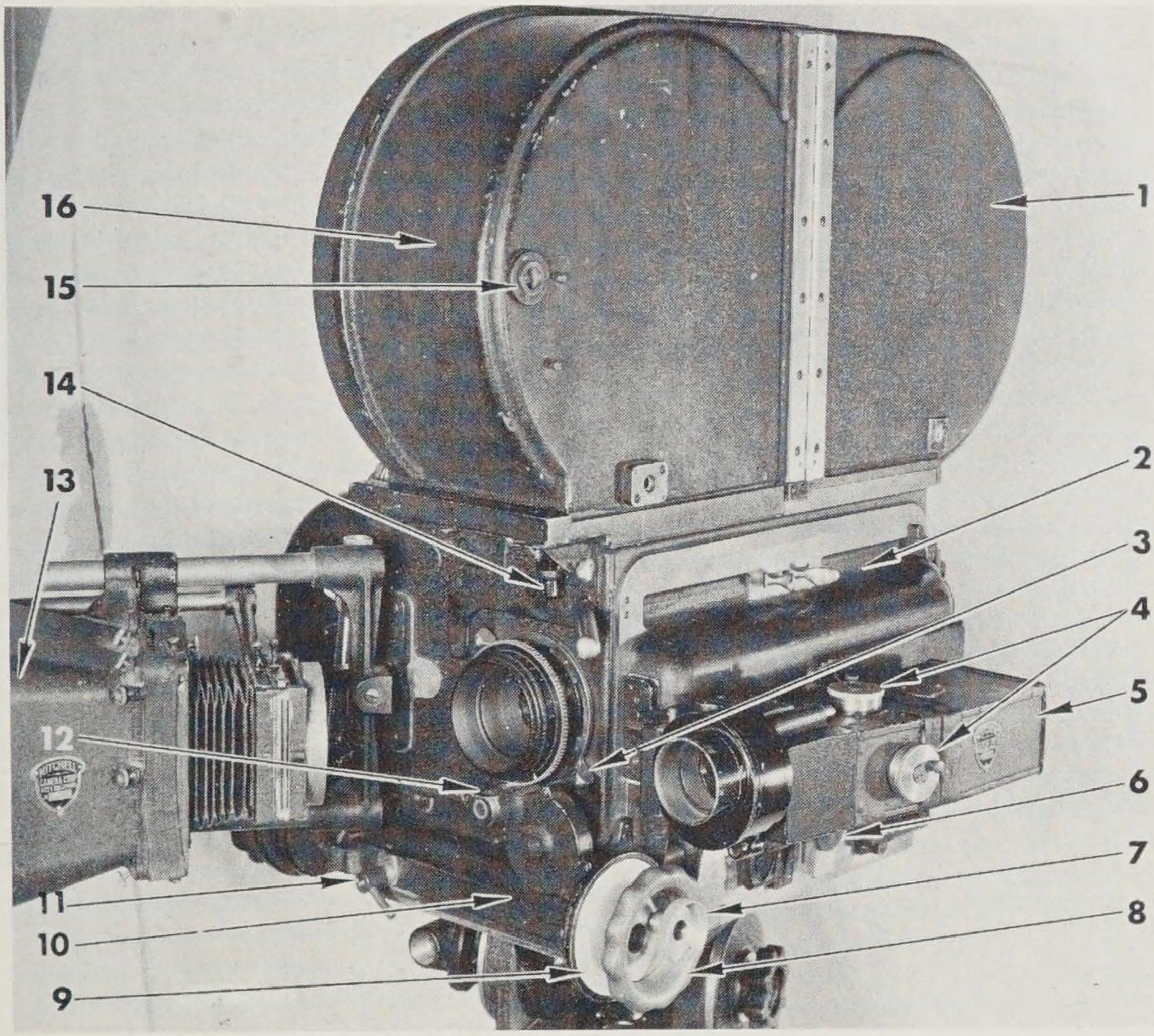


Fig. 16-11. Mitchell BNC (left front). Courtesy of Mitchell Camera Corp.

1. Magazine access door
2. Camera access door
3. Bayonet-type-lens lock
4. Ribbon-matte adjusting knobs
5. Offset viewfinder
6. Focus lock knob
7. Vernier focus knob
8. Follow-focus knob
9. Marking dial
10. Follow-focus knob
11. Follow-focus bracket lock lever
12. Phenolic gear
13. Matte box (in open position)
14. Lens light
15. Eye-light bracket
16. Magazine housing

16.4b Base

Inside main housing. The base is L-shaped, but has *no* turret. Instead, a single bayonet-base lens is mounted through the main housing and locked into place by rotating the lens lock clockwise (see Sec. 16.4h).

The flat section of the base is fitted with dovetail tracks (gibs), allowing the camera to slide (rack over) horizontally to align the focusing tube with the taking lens.

A filter slot is in the upright section of the base.

Four-way mattes (see Fig. 16-13): Used when a split-screen effect is to be achieved "in the camera." Adjustments permit any given size

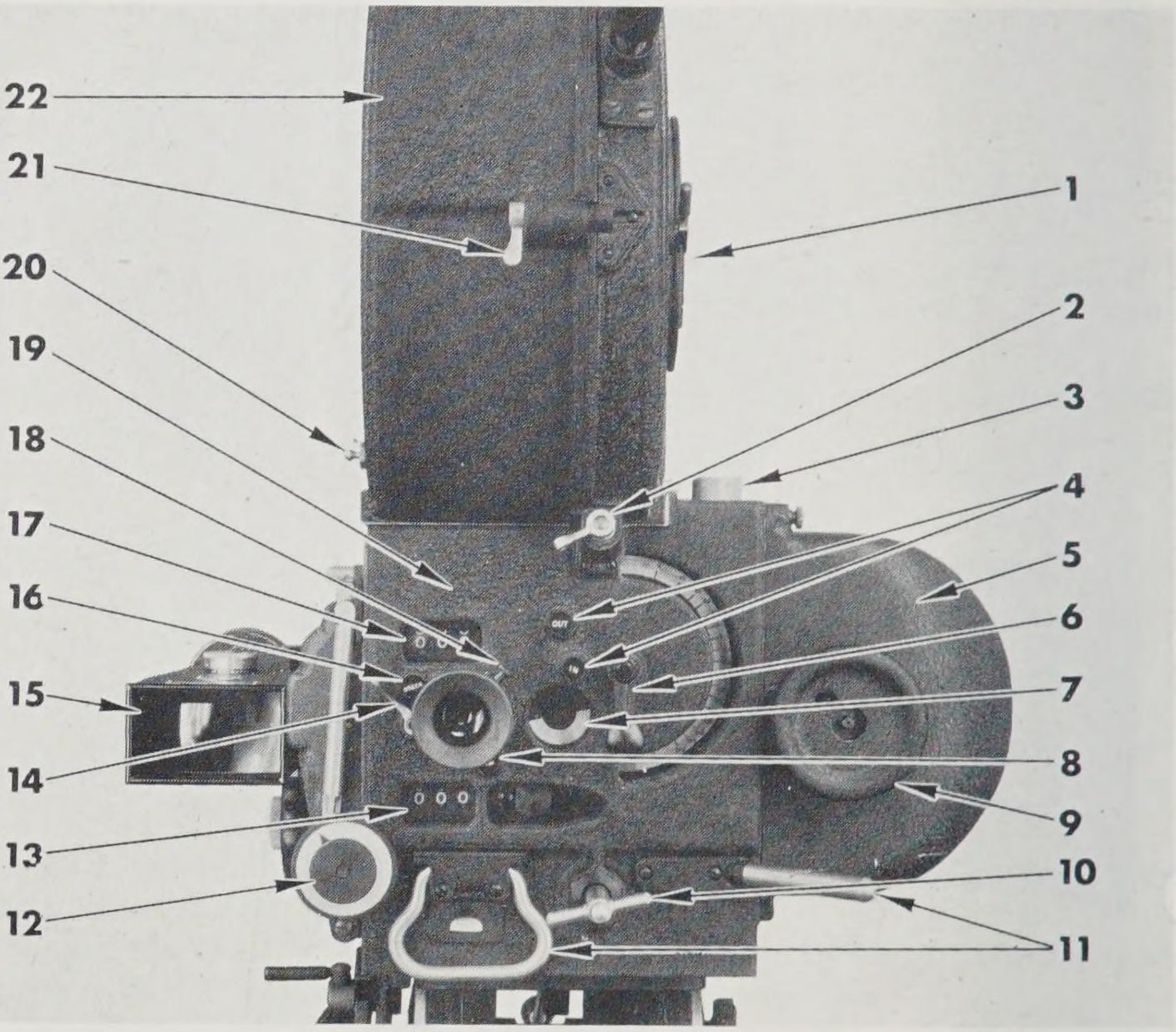


Fig. 16-12. Mitchell BNC (rear view). Courtesy of Mitchell Camera Corp.

1. Viewing ports
2. Magazine-housing lock handle
3. Power-line plug
4. Automatic dissolve control
5. Motor housing
6. Hand dissolve lever
7. Miniature shutter
8. Pan contrast filter
9. Manual motor-turning wheel
10. Rackover handle
11. Carrying handles
12. Vernier focus knob
13. Footage and frame counter
14. Focusing-tube magnification lever
15. Viewfinder
16. Ortho contrast filter
17. Footage totalizer
18. Eyepiece locking screw
19. Main housing
20. Magazine-door stud
21. Magazine-access door lock
22. Magazine housing

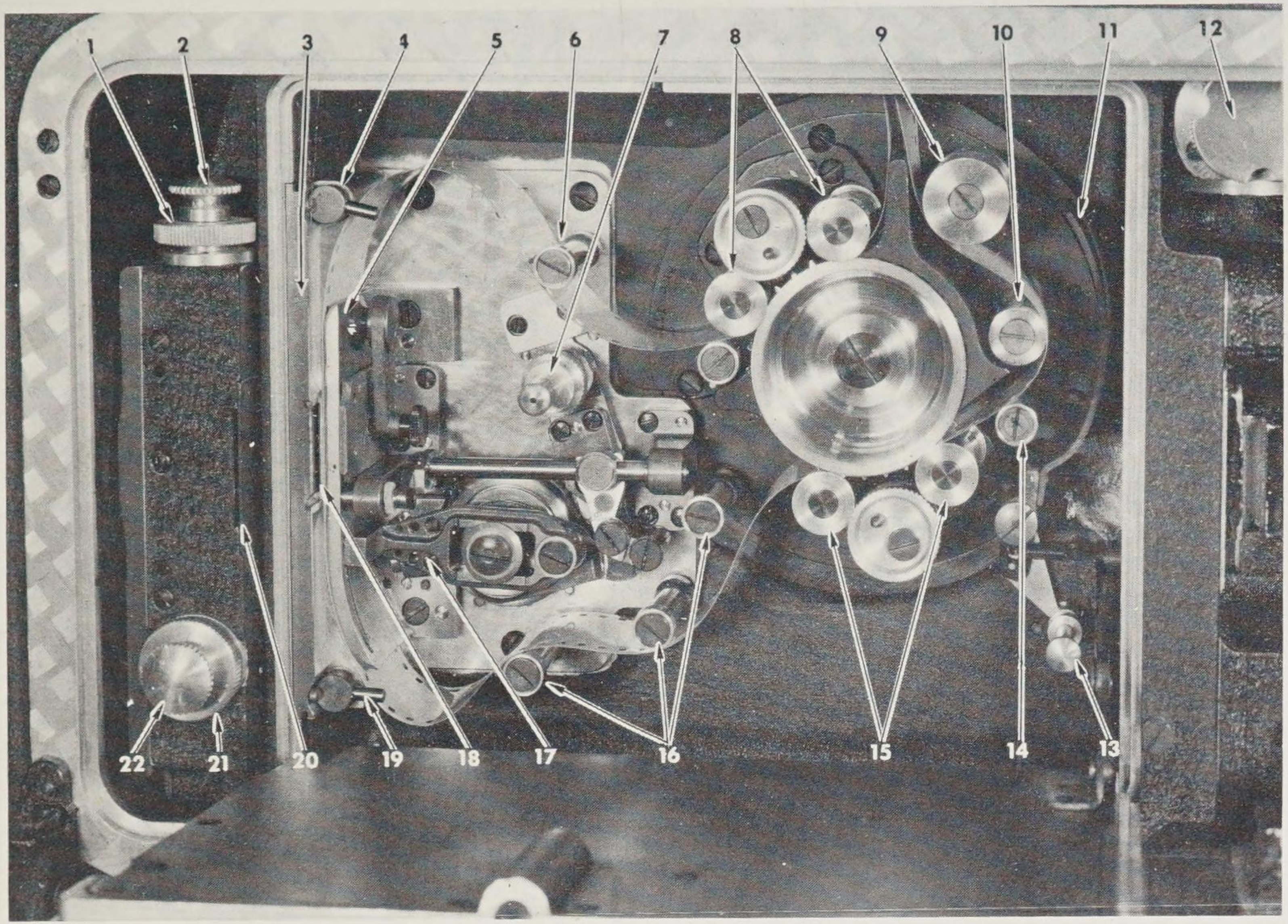
"framing" or division of the screen. Two double knobs (see Fig. 16-7, NC camera) control the mattes, which are located behind the taking lens. The knobs rotate clockwise to move the mattes into the aperture. One double knob is located above the turret. The top half of this knob controls the bottom matte. The lower section controls the upper matte.

The other double knob is located below the viewfinder bracket. The smaller half of this knob controls the right-side matte, the larger half controls the left-side matte.

WARNING: Since mattes can slip or be pushed and loosened, it is important to check matte positions prior to shooting, and at each "hair check," to make certain they have not moved into the aperture thus cutting out a portion of film frame.

Fig. 16-13. Mitchell BNC threading detail. Courtesy of Mitchell Camera Corp.

1. Horizontal top-matte knob (of 4-way matte)
2. Horizontal bottom-matte knob (of 4-way matte)
3. Aperture plate
4. Upper aperture plate lock
5. Register plate
6. Roller
7. Registration-pin throw-out knob
8. Upper sprocket-guide rollers
9. Take-up roller
10. Buckle-trip rolier
11. Buckle-trip apron
12. Magazine lock-down knob
13. Buckle-trip reset knob
14. Buckle-trip roller
15. Lower sprocket-guide rollers
16. Rollers
17. Pulldown claw
18. Matte slot
19. Lower aperture plate lock
20. Filter slot
21. Left vertical matte knob (of 4-way matte)
22. Right vertical matte knob (of 4-way matte)



16.4c Rack over

Camera box must be racked over (i.e., moved laterally on gibs until focusing tube is directly behind taking lens) to sight through the taking lens.

To rack over:

1. Grasp handle at rear of camera (see Fig. 16-12) and depress button to release locating plunger. 2. Start to rotate handle clockwise and *release button immediately* so that the locating plunger can engage the camera box.

CAUTION: Some cameras are *not* equipped with stops to prevent excessive lateral movement of the camera box. Therefore, unless the button is released immediately, the camera can be racked completely off the base.

3. Rotate handle only counterclockwise to check that plunger has engaged the camera box and that the focusing tube is aligned with the taking lens.

CAUTION: Since the camera will run racked over unless fitted with an automatic cutout switch, the camera must be racked back *before* shooting commences.

To rack back:

1. Depress button and start to rotate handle counterclockwise. *Release button immediately* so that the locating plunger can engage the camera box. 2. Rotate handle clockwise to check that locating plunger has engaged the camera box, and that the aperture is aligned with the taking lens.

16.4d Focusing tube: Located in camera box door (see Fig. 16-42).

To change or clean groundglass:

1. Slide access door (at side of focusing tube) toward Operator, open camera door, and insert eraser end of pencil into forward opening of tube. 2. Slide groundglass sideways; grasp glass by edges and remove; clean and reinsert; close access door.

NOTE: *Always* insert groundglass with smooth surface toward rear of tube.

Matte slot: Located forward of the groundglass. Insert academy matte with the bent portion (used as a finger grip) pointed toward the Operator.

Effects matte: A frame of film cut with the Mitchell Matte Cutter (see Sec. 16.11d).

To insert effects matte: Remove the Academy matte from the focusing tube. Slide frame into matte slot upside down, perforations toward the access door.

Magnification: Push spring-loaded magnification lever at rear of main housing (left side of eyepiece) (see Fig. 16-12) to engage notched adjusting knob on camera. Depress lever to magnify tube 10×; push lever up for normal image.

Contrast filters: Two (see Fig. 16-12). Push spring-loaded button above eyepiece to engage rod which flips green filter into view for orthochromatic film. Push spring-loaded button below eyepiece to engage rod which flips pan filter into view for panchromatic film.

Eyepiece (see Fig. 16-12): Rotates; moves in and out; adjusts to achieve focus on groundglass. Locking screw holds eyepiece at desired focus.

16.4e Motors

To mount synchronous motor:

1. Rotate the manual turning gear (at rear of motor) until the drive coupling and the six-pin Cannon plug in motor align with the drive shaft and receptacle in camera; press motor against camera to a snug fit. 2. Slide motor door latch at bottom toward rear of camera. Secure the two knurled screws on the motor to the tapped holes in the camera. 3. Mount motor housing onto main housing (see Sec. 16.4a). Push wheel in (at rear of motor housing) to engage teeth of manual motor-turning gear.

NOTE: The BNC and NC synchronous motors are *not* interchangeable. A BNC has a manual motor-turning *gear* (not shown) at the rear of the motor. This turning gear accommodates the teeth of the internal gear within the BNC Motor Housing (see Sec. 16.4a and Sec. 16.4e). An NC has a manual motor-turning *knob* at the rear of the motor (see Fig. 16-8). Also, a BNC motor is fitted with a 6-pin Cannon plug in the motor which fits to a receptacle in the camera. The NC has *no* Cannon plug in the motor or receptacle in the camera.

Variable-speed motors (Fig. 16-3) *are* interchangeable and are mounted to the BNC as on the NC (see Sec. 16.3d, and Fig. 16-7). However, the vertical configuration of a variable-speed motor prohibits the use of the BNC Motor Housing (see Sec. 16.4a and Fig. 16-12). The resultant motor noise, of course, makes filming with sound impractical.

The following motors are available for the Mitchell BNC:

Variable-speed motor: 12V DC; 110V AC/DC (60 Hz); 110V AC/DC (50 Hz).

NOTE: A variable-speed motor used on a BNC requires a special motor door (see Sec. 16.4e)

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase); 220V AC (60 Hz) (3-phase); 220V AC (50 Hz) (3-phase); 220V AC interlock (3-phase).

Multi-duty motor: 220V AC (60 Hz) (3-phase)/96V DC.

NOTE: Multi-duty motor is only synchronous at 220V AC (60 Hz).

Animation motor: 110V AC (60 Hz); 110V AC (50 Hz).

16.4f Power line

Insert the six-pin Cannon-plug extension of the power line into receptacle at the top-right rear of the main housing (see Fig. 16-12). The ON/OFF switch is in the cable. Motor housing may be fitted

with an ON/OFF switch holder (not shown) but it is not standard equipment.

16.4g Turret: None (see Sec. 16.4b.).

16.4h Lenses

To fit bayonet-base lens to camera through main housing:

1. Lower and lock the follow-focus knob bracket (see Sec. 16.4i). 2. Rotate lens lock on main housing clockwise as far as it will go. 3. Align hole in lens flange with the positioning stud located in the upper left of lens port. Insert the lens flange flush with the camera, making certain the stud engages the lens-flange hole. 4. Rotate lens lock counterclockwise to secure. 5. Align lens gear and phenolic gear. "Witness mark," i.e., a white arrow on the lens gear, denotes proper alignment with white tooth on phenolic gear. (See Sec. 16.4i.)

16.4i Focus and parallax controls.: On main housing (see Fig. 16-11).

To change focus and provide automatic parallax correction of viewfinder: Rotate either of two follow-focus knobs located at both ends of bracket (at front of camera).

Vernier (fine) focus knobs: 3:1 ratio, located within follow-focus knobs and at the rear of the camera (left of the bubble level) for the Operator's use.

A white circular marking disc in back of the follow-focus knob provides an area for penciling follow-focus marks.

To lock focus unit: Rotate focus lock knob (below buckle-trip reset plunger) clockwise in the worm gear.

To align phenolic and lens gears:

1. Rotate follow-focus knobs until cam roller on worm gear is at extreme rear of travel. 2. Release follow-focus bracket lock lever. Depress right side of follow-focus bracket and secure it by rotating the follow-focus bracket lock lever counterclockwise. 3. Insert lens in camera (see Sec. 16.4h). 4. Rotate "witness mark" on lens gear so that it faces the phenolic gear. 5. Align white scribed tooth on phenolic gear with "witness mark" of lens gear. 6. Release follow-focus bracket lock lever and engage phenolic scribed tooth with lens "witness mark"; secure follow-focus bracket lock lever. 7. Rotate follow-focus knob to check tension and meshing of gears. If tension is too great, camera noise will transmit through lens; if too loose, phenolic gear will vibrate in sympathy with motor.

To mesh gears properly:

1. Loosen nut on hex-head screw above follow-focus bracket lock lever. 2. Rotate hex-head screw until gears just mesh with no air space between them. 3. Back the hex-head screw off until phenolic gear drops away from lens gear (approximately one half-turn). A slight air space should be discernable. 4. Run camera. If noise persists, back the hex screw off more. 5. Secure lock nut on hex-head screw.

16.4j Viewfinder

Offset (see Fig. 16-11). Fits and locks into dovetail bracket in door of main housing.

Cams: 35mm, 40mm, 50mm, 75mm, and 100mm cams (not shown) are attached underneath finder and fold under when not in use. The cam corresponding to focal length of lens being used is flipped out so that it will ride the cam roller and provide automatic parallax correction to finder.

The 100mm cam is slotted and punched with alignment holes to accept auxiliary (wide-angle) cams (18.5mm, 25mm, and 30mm).

To mount auxiliary cams:

1. Flip 100mm cam out. Insert auxiliary cam pins from bottom into slot and holes of 100mm cam. 2. Slide lock on 100mm cam forward to secure auxiliary cam.

NOTE: Auxiliary cams must be removed in order to use the normal complement of cams.

Ribbon-matte–adjusting knobs: Located at top and left side of finder, scribed to indicate various focal-length settings. *Wide-angle lenses* (25mm, 30mm, and 35mm) are scribed in red. *Normal and long lenses* (40–100mm only) are scribed in black. Knobs may be set to two different indicators: projector or TV. Top knob adjusts vertical ribbon mattes (frame sides). Side knob adjusts horizontal ribbon mattes (frame top and bottom).

When using a wide-angle lens, remove the threaded circular sunshade at the front of the finder and replace it with a *reducer lens.*

When using an 18.5mm lens the fields of the focusing tube, and that of the viewfinder with a reducer lens attached, must be compared visually so as to set the top and bottom frame lines in the viewfinder. Side lines will not match (the viewfinder cannot "see" as wide as the lens). The camera Operator must make allowance for the viewfinder cut-in and frame the scene accordingly.

Without the reducer lens, the full field of the viewfinder approximates 35mm.

Parallax adjustment: Automatic. A viewfinder return spring next to the dovetail locking lever exerts tension against the finder. This forces the finder cam against the cam roller on the worm gear, which in turn regulates parallax and focus of the finder.

NOTE: To insert finder easily into the dovetail bracket, place the forefinger of the right hand between the circular prism box and the viewing assembly. Fold cams under, insert finder dovetail into dovetail bracket on door, release the finder, and secure the finder dovetail locking lever forward.

Horizontal–cross-hair adjustment: None. Finder is factory adjusted. Misalignment would be due to (1) improper riding of cam on roller, or (2) improper insertion of finder in dovetail bracket.

Focus knob: None on finder. Focus is automatic.

Pivot point: None. Finder locks in bracket in door of main housing, drops down with door for access to camera interior.

16.4k Sunshade/matte box (see Fig. 16-11)

Bellows sunshade/matte box mounts on two rods, one above the

other, which fit into a vertical bracket pivot attached to front of main housing. Matte box swings aside for access to lens mount (see Fig. 16-11). The sunshade/matte box moves in and out only on the rods. Top of the matte box is fitted with an extension-shade screw.

To verify clearance: Sight through focusing tube, run forefinger around inner edge of matte-box opening. If tip of finger is visible, move entire unit toward lens. Repeat checking until matte box is clear of lens. A BNC standard matte box allows use of a 35mm lens if its bellows is fully collapsed; a BNC wide-angle matte box is necessary to use a 25mm or 30mm lens. The matte box must be removed entirely to use a lens wider than 25mm.

16.4l Filters

Gauze frames and mattes are housed in the matte box. Three 3 × 3 in. filter holders are housed at the rear of the bellows. A wide-angle matte box houses three 4 × 4 in. filter holders and has no bellows.

Gelatine: Slot for internal filter is located in upright section of base (see Fig. 16-13). When inserting filter holder the bent portion of holder (used as a finger-grip) should be pointed AWAY from the Operator (opposite from all other Mitchell cameras) to avoid the possibility of excess rackback of the camera box catching the bent portion of the holder. Excess rackback can pull the gelatine holder out of the slot just enough to cause it to cover a portion of the aperture and a partially exposed frame will result.

To check filter after insertion of holder: Rack camera over; open the camera door and expose aperture opening in upright section of the base. Determine visually that gelatine "covers" the aperture.

16.4m Door: Hinged at bottom.

To open: Depress catch in door; pull out and down.

To close: Lift up until flush with camera; pull focusing tube to verify that door is secure.

16.4n Magazines: 400-ft and 1000-ft (see Fig. 16-6).

To mount:

1. Pull the magazine belt through the rear port of the magazine housing and close port window on the belt to hold it out of the way. 2. Pull a film loop from the magazine feed side. 3. Insert the magazine toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 4. Slide magazine forward and down until tapped hole in heel aligns to the magazine lockdown screw. Rotate the magazine lockdown knob at the left side of the camera clockwise to tighten magazine to camera. Thread camera (see Sec. 16.4o).

To remove magazine: Unthread film and break it. Place two fingers under the belt, pull laterally away from the magazine. Rotate fingers clockwise and lift the belt from the spindle wheel grooves. Disengage the magazine by rotating the lockdown knob counterclockwise, and lift the magazine clear of camera and out of the housing.

16.4o Threading (Fig. 16-13)

1. Press buckle-trip apron toward rear of camera to avoid accidental starting of camera during threading procedures (see Sec. 16.4p). Rotate upper and lower sprocket-guide rollers counterclockwise away from the sprocket (on early models, rotate the sprocket-guide rollers clockwise). 2. Depress and rotate manual turning wheel on motor housing (see Fig. 16-12) until pulldown claw retracts from the register plate (a back and upward stroke). Pull the registration-pin throw-out knob and move it toward the rear of the camera. 3. Raise upper and lower aperture-plate locks, and remove aperture plate by pulling *gently*. If plate does not slide easily, check to see that pulldown claw and/or registration pins are clear of plate. 4. Clean plate. Make a special check of the pulldown claw and registration-pin holes for emulsion build-up or film chips; replace plate. Depress aperture-plate locks to secure. 5. Swing pressure-plate spring arm clockwise. Remove pressure plate from register plate. Clean, making sure rollers revolve freely. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to lower front corner of camera (a rough guide for amount of film needed for threading).

Starting clockwise from the magazine take-up side, insert film: (a) Under large take-up film roller nearest to the magazine take-up rollers, then to right of buckle-trip roller. (b) Then to left of small roller, and between the lower sprocket-guide rollers and sprocket. (c) *Under* small lower roller at left of sprocket-guide rollers, and *over* small roller below pulldown claw eccentric.

Starting counterclockwise from the magazine feed side, insert film: (a) Between upper sprocket-guide rollers, and *under* small roller above registration-pin throw-out knob. (b) Then in groove (the race) between the removable aperture plate and stationary register plate.

7. Hold film in race, pull registration-pin throw-out knob and move it toward the aperture plate *gently* to determine whether registration pins are entering the film perforations. If pins touch film, raise or lower the film in the race while moving the throw-out knob back and forth until the pins engage the perforations. 8. (a) Adjust lower loop so that when the lower sprocket-guide roller closes, the loop will clear the bottom of camera interior by 1/8–1/4 in. at lowest arc of the loop. (b) Adjust upper loop so that when the upper sprocket-guide roller closes, the top of the loop aligns with the top of the movement plate. 9. Rotate the magazine take-up spindle wheel clockwise to take up film slack. Place uncrossed belt at bottom of take-up spindle wheel, and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel, and subjects the belt to a minimum of stretching). 10. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 11. 11. Pull buckle-trip reset knob (inside camera below buckle-trip apron); hold pins on upper and lower sprocket-guide rollers with thumb and forefinger.

CAUTION: Keep the knuckles of the hand clear of the movement!

Apply power in short bursts and observe action of film. If satisfactory, stop camera, close door, and reset footage counter.

16.4p Buckle-trip

Apron (a curved metal plate) located behind take-up side of the sprocket (see Fig. 16-13). The apron cuts out power automatically if film fails to take up when camera is running. Power should be deliberately cut out prior to threading (by tripping apron toward rear of camera) to prevent accidental starting of camera.

To reset: (1) Pull buckle-trip reset knob below apron until unit snaps forward or, (2) push reset plunger (not shown) (at lower left edge of main housing door, below rear of viewfinder).

16.4q Footage and frame counters

Viewed through lower window at rear of main housing, above the bubble level (see Fig. 16-12).

Footage counter: Additive. Registers each foot of film transported through the camera up to 999 ft, then reverts back to zero and counts forward again. May be reset to zero each time magazine is changed; reset knob is located at left-rear side near camera door, inside main housing.

Frame counter is additive in increments of one frame up to 16 frames, then back to one. Does not reset.

Footage totalizer (see Fig. 16-12): Viewed through upper window at rear of camera above eyepiece. Additive. Registers each foot up to 999 ft then reverts back to zero and counts forward again. Has no frame counter. The totalizer provides total footage count exposed on a roll when the footage counter is reset to zero before all the film in the magazine is expended. This occurs when a specific length of a scene is needed (e.g., double exposure, special effect, etc.). Reset knob is located at left side of camera, above eyepiece, inside main housing.

> NOTE: Most camera crews cover the totalizer window with black masking tape when it is not being used to avoid confusion between the two counters and/or to eliminate having to zero both counters at every magazine change.

16.4r Tachometer: None on camera.

16.4s Shutter

Variable; 0–175°. Calibrations and pointer can be viewed through semicircular window at rear of main housing. External control lever is at back of main housing (Fig. 16-12).

To change shutter opening:

1. Align shutter-arm lever with pointer. 2. Push shutter-arm lever in until spring-loaded lever engages notched shutter knob. 3. Rotate pointer to desired shutter opening and release lever.

Automatic dissolve: Depress either of two buttons located at left of shutter-arm lever to provide a 4-ft fade-in or fade-out while the camera

is running. Top (OUT) button closes the shutter to the fade-out scene. Lower (IN) button opens the shutter to fade-in scene.

Miniature shutter: At rear of camera below automatic dissolve buttons. Circular dial is scribed with a miniature aperture. The miniature aperture provides an easy visual check of the shutter opening and its position in relation to the camera aperture. The black area of the dial conforms to adjustments made to the camera shutter. The white area of the dial denotes the degrees of shutter opening. The miniature shutter rotates in synchronization with the camera shutter.

To clear the shutter from the lens: Depress and rotate manual motor-turning wheel on motor housing (see Fig. 16-12) until the white area of the miniature shutter fills the miniature-aperture scribe.

16.4t Lubrication (Fig. 16-14)

Manufacturer recommends lubrication of the following parts every 2000 ft with one or two drops of camera oil:

Eccentric (movement): Registration-pin pads; plunger arm and bracket (both sides); sliding block, rear bearing, sliding-block bearing of pulldown claw; eccentric-arm bearing, timing-block unit.

Rollers: Every 10,000 ft, except for the large take-up roller and buckle-trip roller, which should be lubricated every 3000 ft.

Pressure-plate rollers: Every 10,000 ft.

NOTE: After oiling, run camera to eliminate excess oil and wipe interior.

16.4u Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

16.4v Weight: (with 1000-ft load) 122 lb.

16.4w Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; camera racked over; power-line connection faulty; low temperature
Camera "hunts"	Camera not warmed up; voltage variation in power line
Camera door will not close	Sprocket-guide rollers not seated properly; registration-pin throw-out knob not forward; film chip or dirt in door
Film jam	Improper threading; take-up belt not on;

Trouble	*Probable Cause*
	magazine cover not relieved on "dished" roll
Lens will not focus	Mount not seated properly; lens damaged
Viewfinder does not match focusing tube cross hair	Wrong cam "up" on finder; camera not completely racked over; viewfinder not properly seated in dovetail bracket; wrong lens on front of viewfinder
Focusing tube blurred	Magnification knob seated between magnifying position (forward) and normal position (back)
Cut-in on focusing tube	Internal filter holder not seated; matte in tube not seated; matte box extended; four-way mattes not wide open
Torn or punctured film	Improper threading
Film will not slide into race	Registration pin or pulldown claw not retracted; emulsion or film chip in race
Film scratches	Dirt or emulsion build-up on the following: aperture plate, sprocket-guide rollers, pressure plate, registration pins; magazine rollers
No take-up, or sporadic take-up	Belt slipping, or belt too loose

16.4x BNC magazine-loading instructions: See Sec. 16.2.

16.5 35mm MITCHELL S35R/MARK II CAMERA (Figs. 16-15, 16-16)

NOTE: All directions are from the Operator's point of view.

NOTE: In 1965 the manufacturer redesigned the Reflex "Mark II" to incorporate additional features. The redesigned camera is now identified as the Mitchell Reflex "S35R"; the Mark II camera is no longer manufactured. Because of similarities in basic design, appearance and utilization of the same accessories, the S35R camera is often referred to as the Mark II, R35, or Mitchell Reflex. The standard Mark II, however, has two mounting positions for the film magazines—slant load and inverted, while the S35R has three mounting positions—slant load, inverted, and top load. (There are many Mark II cameras in use which have been mechanically converted for top loading by someone other than the Mitchell Camera Corp. These cameras should not be confused with the standard S35R.) Additional features in the S35R are: removable, repositioned drive belt for top and slant load magazines; double buckle-trip system; improved slant magazine adapter; improved shutter-control mechanism permitting use of the camera with

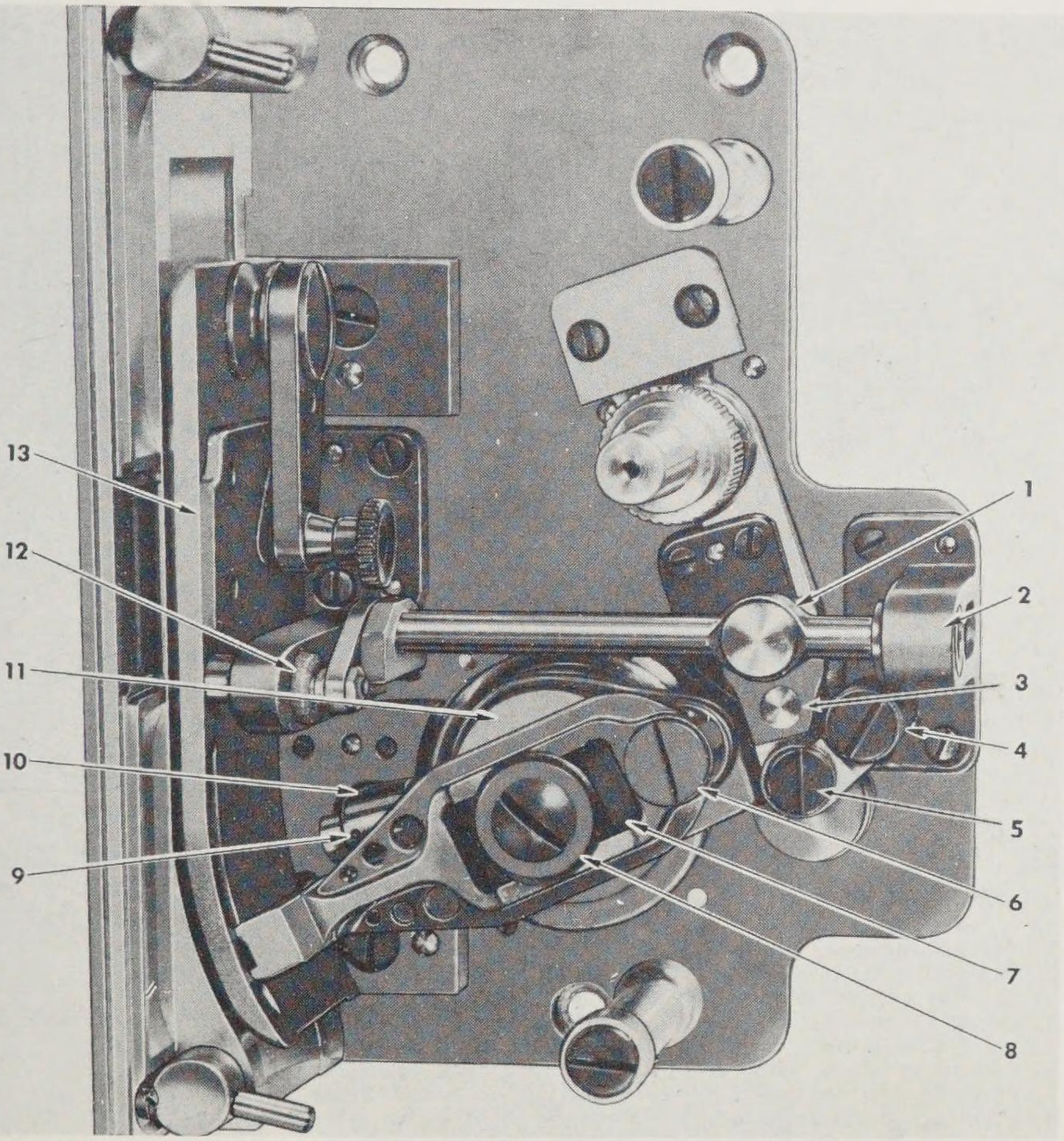


Fig. 16-14. Mitchell BNC eccentric lubrication. Courtesy of Mitchell Camera Corp.

1. Swivel block
2. Plunger-arm bracket
3. Pivot-arm bearing
4. Toggle arm
5. Toggle arm
6. Rear bearing
7. Sliding block
8. Sliding-back bearing
9. Eccentric-arm bearing
10. Timing-block unit
11. Eccentric-arm bearing
12. Registration-pin pads (oilers)
13. Pressure-plate rollers

the S35R sound blimp; less weight and more quiet operation; improved internal mechanical features; and groundglass that is removable through the lens port without removing the turret.

This section describes both the Mark II and the S35R cameras. Directions apply to both unless otherwise noted.

16.5a Base

Bottom fitted with two ⅜"-16 tapped holes to accommodate tripod locking screw and/or adapter plate screw. The forward tapped hole

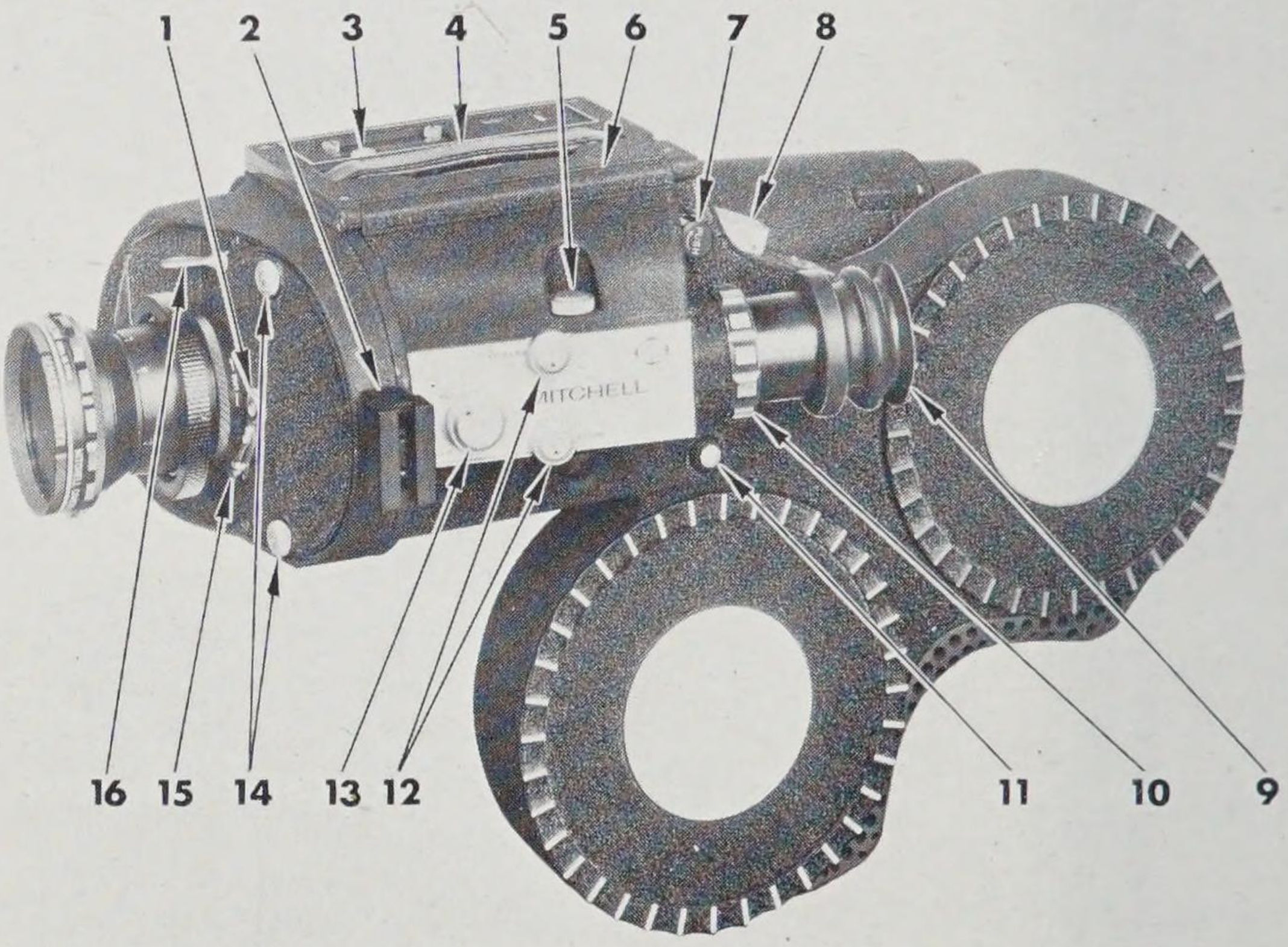


Fig. 16-15. Mitchell S35R with inverted magazine. Courtesy of Mitchell Camera Corp.

1. Turret-holddown screw
2. Dovetail (offset-viewfinder) bracket
3. Shutter control knob
4. Carrying handle
5. Light-trap knob
6. Top-cover plate (shoe removed)
7. Footage counter reset knob
8. Inverted magazine lockdown knob
9. Eyepiece
10. Eyepiece locking ring
11. Short-burst button
12. Contrast-filter knobs
13. Hi/Lo magnification knob
14. Turret locks
15. Lens-mount lock
16. Turret-release lever

is utilized to secure the camera when it is placed on a Mark II/S35R hi-hat, or as a locating receptacle when the camera is placed on an adapter plate.

The Mark II/S35R does *not* have an L-shaped base; it has *no* rack-over and *no* four-way mattes.

16.5b Hi-hat

Required when a camera with a 400-ft inverted magazine is to be mounted on a tripod (not shown). Base of the hi-hat is fitted with a ⅜″-16 tapped hole to accommodate a tripod lockdown screw. A handle at the right side rotates a ⅜″-16 camera lockdown screw at the top of the hi-hat. The unit is secured to the forward tapped hole in the camera base, so that the take-up compartment of the 400-ft inverted magazine conforms to the curvature of the hi-hat.

16.5c Adapter plate (not shown)

Required when a sunshade/matte box, a follow-focus unit, or a zoom lens cradle is used with the camera. Top of the plate is fitted

with a forward locating pin which is inserted into the forward tapped hole of the camera base. A large knob located between the top and the base of the plate has a ⅜"-16 threaded screw which is inserted in the back tapped hole of the camera base.

Bottom of the plate is fitted with four ⅜"-16 tapped holes for variety of placement on a tripod or geared head.

Insert matte box rods in the lower front of the plate and secure with retaining screws.

Upper left front of the adapter plate has tapped holes for attaching a follow-focus unit.

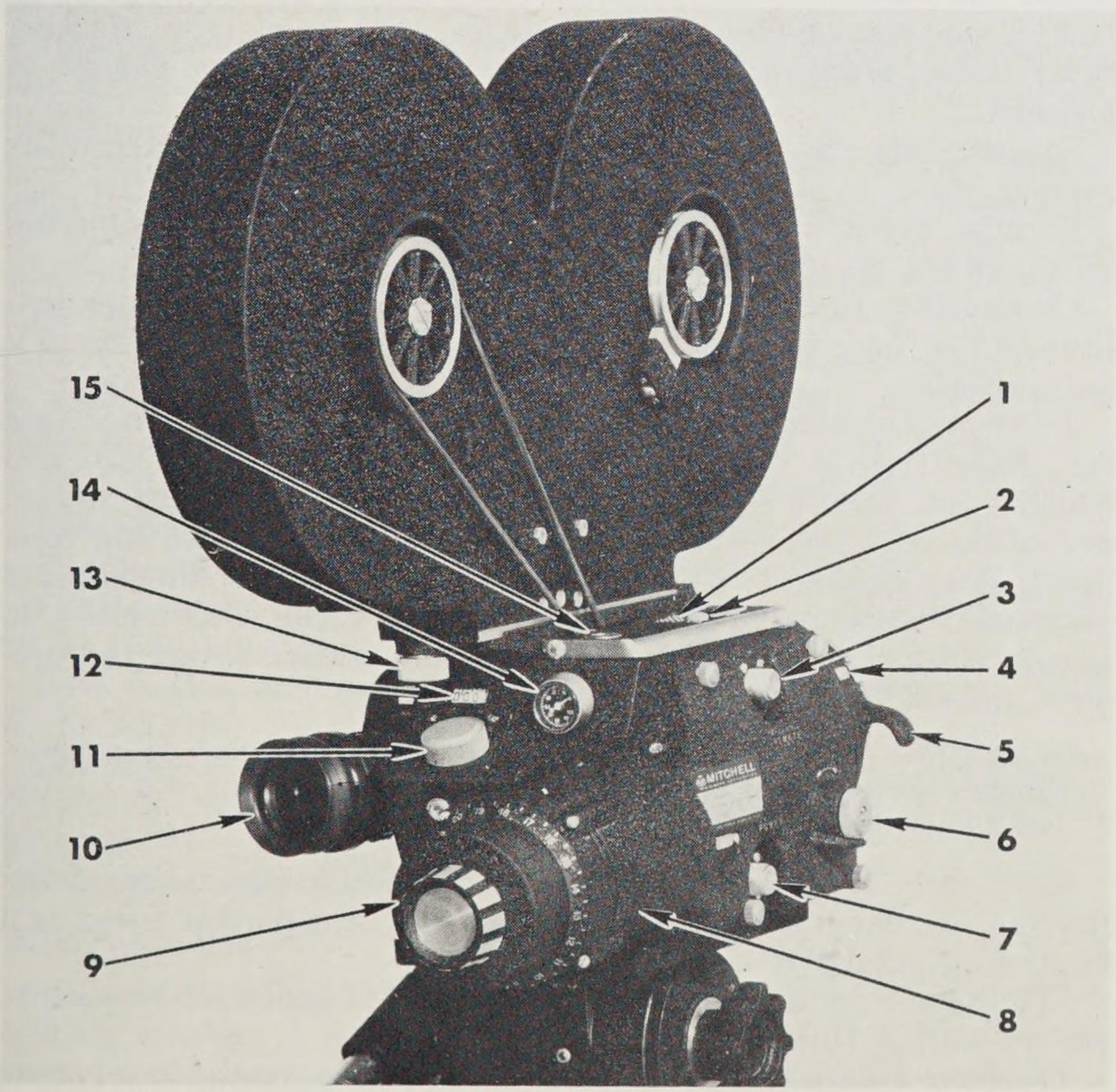


Fig. 16-16. Mitchell S35R with top load (rear view). Courtesy of Mitchell Camera Corp.

1. Shutter scale calibrations
2. Shutter control
3. Remote connector
4. Turret ON/OFF switch
5. Thumb grip
6. Manual motor-turning knob
7. Power-line plug
8. Variable-speed motor
9. Motor rheostat
10. Eyepiece
11. Dust cover-plate holddown knob/ inverted magazine lockdown knob
12. Footage counter
13. Magazine lockdown knob
14. Tachometer
15. Bullseye level

To mount zoom lens cradle:

1. Mount matte box rods in adapter; slide inverted U-bracket onto rods. 2. Insert short cradle rods into inverted U-bracket; slide adjustable cradle on short rods. Adjust rods and brackets to zoom lens. Secure all retaining screws.

16.5d Viewfinder/focusing tube

Reflex (see Fig. 16-15). There is also a dovetail bracket into which an offset viewfinder may be inserted. There are three types of offset viewfinders available for use with this camera: (1) BNC-type, with captive cams and automatic focus (see Sec. 16.4j); (2) NC-type (Fig. 16-41), with manual focus (see Sec. 16.3h); (3) frame-type (tracking finder) (not shown), with transparent colored mattes for change of field size.

Focusing tube: In camera-box door as an integral part of the reflex system.

To align reflex mirror for viewing: Rotate manual motor-turning knob (see Fig. 16-16).

Groundglass: Located behind turret. Views more than full aperture. Groundglass may be scribed with full aperture, Academy or TV aperture fields.

To change or clean groundglass: On Mark II: Remove turret (see Sec. 16.5g); grasp groundglass by edges, pull forward. Clean and reinsert with smooth surface facing the eyepiece, granulated surface toward the reflex shutter. Replace turret. *On S35R:* Remove lens from turret. Wrap forefinger with lens tissue, reach forefinger through lens port and slide groundglass toward opening. Clean and reinsert in camera using the same method with smooth surface facing the eyepiece, granulated surface toward the reflex shutter.

> WARNING: On both cameras it is extremely important to reach through the lens port and push the groundglass into its stop each time the camera is set up.

Matte slot: Located forward of the groundglass (toward the reflex shutter). Academy matte is inserted with the bent portion (used as a finger grip) pointed toward the operator.

Effects matte: A frame of film cut with the Mitchell book-type matte cutter (see Sec. 16.11d).

To insert effects matte: Remove the Academy matte from matte slot. Slide frame into matte slot upside down, perforations toward lens port.

Magnification: Rotate large knob in door counterclockwise ("HI") to magnify 10×; clockwise ("LO") for normal viewing to magnify 5×.

Contrast filters: Two. Knob at top flips filter (Eastman negative viewing filter, minus blue, 10 per cent white-light transmission) into view for color film. Knob at bottom flips pan filter (No. 74U on the Spectro Wedge; Wratten 90G; Harrison and Harrison YL-9) into view for black-and-white film.

Eyepiece: Slides in and out; adjusts to achieve focus on groundglass. Knurled locking ring holds eyepiece at individual's focus.

Light trap: Horizontal knob (in door recess) rotates to close viewing system. It should be closed when an offset viewfinder is used in place of the reflex system.

16.5e Motors

Synchronous motors (not shown): Have a manual turning knob at the back which extends at a right angle to the camera when mounted. Therefore the Operator reaches to the side of the camera to rotate the sync motor-turning knob.

Variable-speed motors (shown): Have a manual turning knob at the side; speed control rheostat at the back, and a FWD/REV switch at the side.

To mount synchronous or variable-speed motor: Rotate manual motor-turning knob until drive coupling aligns with camera drive shaft and five-pin Cannon plug aligns with receptacle in camera. Press motor to camera for snug fit. Secure four knurled screws on motor to tapped holes in camera.

To reverse variable-speed motor: Turn motor switch to REV. Transfer the belt from take-up to feed spindle wheel. Loop the belt into a "figure 8" to cause feed to act as "take-up"; adjust motor speed.

CAUTION: Cover lens or close shutter when running film back to beginning of a scene intended for double exposure.

The following motors are available for the Mitchell S35R:

Variable-speed motor: 24V DC; 110V AC/DC (60 Hz); 110V AC/DC (50 Hz).

Slow motion motor: 110V AC/DC (60 Hz) (36–128 fps); 110V AC/DC (50 Hz) (36–128 fps).

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase); 220V AC (60 Hz) (3-phase); 220V AC (50 Hz) (3-phase).

Animation motor: 115V (50/60 Hz) AC.

16.5f Power line

Elbowed three-pin Cannon plug is inserted into motor. ON/OFF switch is in cable.

NOTE: A thumb-actuated ON/OFF switch is at top right of the turret housing cover, above the hand grip. This switch should be taped to hold it in the forward position when using the ON/OFF switch in the cable.

The remote connector plug on the motor accommodates an extension cable when a pistol grip accessory is used.

A short-burst button is at lower rear of the door.

A synchronous-generator Cannon-plug connection is located at the back of camera below the tachometer. Pins read clockwise starting from key: A and B, mid-shutter pulse (an optional feature when indi-

cation of shutter position is required); C–F, dual timing lights (another optional feature that marks the film outside the perforation holes to indicate the beginning and end of scenes or segments of scenes); G and H, camera synchronous generator that provides a frequency signal to the sound recorder.

16.5g Turret

Single-lens turret is standard equipment; three-lens turret optional.

To rotate three-lens turret: Depress turret release lever (upper right); turn turret to bring desired lens into position, then release lever, which locks turret.

To remove turret:

1. Remove slotted screw from knurled holddown screw in center of turret; remove holddown screw. 2a. *Single-lens turret:* Rotate turret locks clockwise at top and bottom; depress turret release lever; pull turret from housing. 2b. *Three-lens turret:* Depress turret release lever, pull turret from housing.

To replace turret:

1. Depress turret release lever, slide turret into housing; rotate turret until release lever snaps into *up* position. 2. Install knurled holddown screw and hand-tighten until screw touches the turret locating face; back the screw off 1/16 of a turn. 3. Depress release lever and rotate turret. Feel for slight drag on holddown screw. If satisfactory, allow the turret release lever to snap into *up* position, and insert the slotted screw into the knurled holddown screw and tighten. 4. Try to rotate turret in both directions. If rigid, turret is properly seated. If unit moves, remove turret and begin again. 5. *On single-lens turret only:* Rotate turret locks (at top and bottom) counterclockwise after rigidity of turret is found satisfactory.

16.5h Lenses

Bayonet-base. Three protrusions (bayonets) on the base are spaced so that the lens can be inserted into turret one way only. One bayonet is usually marked with a dot that aligns with a similar dot on the turret. On lenses without this feature, the lens focus and/or T stop arrow is to be placed at "6 o'clock" and the lens abutted to the lens port then rotated until the bayonets on the base slide into the bayonet guides on the turret.

To mount:

1. Hold lens by forward scalloped ring, align the lens (as above), and insert into turret. 2. Rotate lens counterclockwise until lens-mount lock below the lens secures the mount to the turret. 3. Try to rotate the lens clockwise to determine that lens is seated and locked.

To remove: Hold lens by forward scalloped ring and depress lens-mount lock below the lens. Rotate lens clockwise, withdraw slowly.

NOTE: (a) When used with a follow-focus unit or in a blimp the scalloped focus ring is replaced by a geared ring. (b) Each mount is fitted with a focus lockdown ring. (c) Each mount is fitted with a screw-out filter retaining ring.

16.5i Sunshade/matte box (not shown)

Bellows sunshade/matte box mounts on two rods that fit into adapter plate. Camera must be mounted on the adapter plate to utilize sunshade/matte box.

Sunshade/matte box is adjustable in and out. It accommodates all lenses—wide-angle (20mm) to telephoto (152mm), and zoom lens. Left side of matte box is hinged to permit field clearance when offset viewfinder is used on the camera. Bellows can be detached from matte box.

To verify clearance: Sight through reflex system; run forefinger around inner edge of matte-box opening—if tip of finger is visible, move entire unit toward lens.

16.5j Filters

Pola-screen and 5 × 5 in. glass filters can be housed in the sunshade/matte box bellows.

Each Super Baltar lens (standard equipment) can accommodate a circular glass filter in its retaining ring (20mm and 25mm, 4 in. in diameter; 35mm, Series 7; 50mm, 75mm, 100mm, and 152mm, Series 8).

Gelatine: Filter slot located in aperture plate (see Fig. 16-17). Bent portion of holder (used as a finger grip) should be pointed toward the Operator.

CAUTION: The raised nibs in the holder (intended for pressure-tight retention of the holder in the plate) have a tendency to stop the holder before it is fully inserted. Therefore, after insertion of the holder into the plate, remove plate from camera and inspect to determine that gelatine fully "covers" all of the aperture-plate opening.

CAUTION: Manufacturer emphasizes frequent inspection of the filter. Dirt or lint on the gelatine may register on the film when the lens is stopped down. Manufacturer recommends that gelatine filter be removed and inspected after each "take." Many Cameramen refuse to use the internal filter.

16.5k Door: Hinged at top.

To open: Raise catch in door, lift up.

To close: Lift door to clear hinge catch, then lower until flush with camera. Grasp viewing tube and pull to verify that door is secure.

16.5l Magazines: 400-ft and 1000-ft.

NOTE: On the S35R, 400-ft magazines may be mounted one of three ways: inverted, slant load, or top load. A 1000-ft magazine may be slant- or top-mounted only.

Inverted magazine (see Figs. 16-15, 16-18):

To mount:

1. Rotate inverted-magazine lockdown knob (below footage counter) counterclockwise and remove dust-cover plate from rear of camera. Pull film loop from magazine feed side. 2. Insert loop carefully into camera. Slide magazine into camera-body guide grooves until tapped hole in magazine aligns with the magazine lockdown screw. 3. Be sure

camera and magazine drive gears are properly meshed. Rotate inverted magazine lockdown knob clockwise to tighten magazine to camera. Thread camera (see Sec. 16.5m).

To remove: Unthread film and break it; rotate inverted magazine lockdown knob counterclockwise and pull magazine away.

Slant-load magazine (not shown):

To place a slant-load adapter on a top-load camera:

1. Remove the screws that secure the top-load–magazine guide groove (the shoe) to the top of the camera. 2. Insert a top-cover plate in the depressed cut in the camera top (to provide a lighttight cover). Secure top-cover plate with screws referred to in 1 above. 3. Rotate inverted-magazine lockdown knob (below footage counter) and remove dust cover plate from the rear of camera. 4. Align adapter with inverted-magazine lockdown screw extending from rear of camera, and slide the adapter into camera-body guide grooves until gears mesh. Rotate inverted-magazine lockdown knob clockwise to secure adapter to camera body.

NOTE: The Mark II slant-load adapter has a top lockdown screw located in the front of the slant-load magazine guide groove. This screw inserts into camera body in a tapped hole above footage counter. The S35R adapter is provided with an upper hold-down lip instead of a screw.

5. Rotate manual motor turning knob (see Fig. 16-16) to verify that gears are properly meshed.

To mount a slant-load magazine:

1. Remove adapter door at left side of adapter throat. Insert magazine toe into the magazine guide groove (the shoe). Draw film loop through adapter throat (feed side under top roller, take-up side under lower roller) and into camera body. 2. Slide magazine forward and down until tapped hole in magazine heel aligns with the magazine lockdown screw in the adapter. Rotate adapter magazine lockdown knob at bottom of rear plate clockwise to tighten magazine to adapter. Thread camera (see Sec. 16.5m).

WARNING, CAUTION, NOTE: Replace the adapter door!

To remove: Unthread film and break it. Remove adapter door. Place two fingers under magazine belt, pull laterally away from magazine; rotate fingers clockwise and lift belt from spindle-wheel grooves. Rotate adapter magazine lockdown knob counterclockwise. Lift magazine.

Top-load magazine (S35R and modified Mark II—see Figs. 16-16, 16-17):

To mount:

1. Pull film loop from magazine feed side. 2. Insert magazine toe into magazine guide groove (the shoe); draw the film loop into camera body. 3. Slide magazine forward and down until tapped hole in the magazine heel aligns with the top-load magazine lockdown screw.

Rotate screw knob clockwise to tighten magazine. Thread camera (see Sec. 16.5m).

To remove: Unthread film and break it. Place two fingers under magazine belt, pull laterally away from magazine; rotate fingers clockwise and lift belt from spindle-wheel grooves. Rotate top-load magazine lockdown knob counterclockwise. Lift magazine.

16.5m Threading (Figs. 16-17, 16-18)

1. Depress buckle-trip apron toward rear of camera prior to threading to avoid accidental starting of camera (see Sec. 16.5n). *On the S35R and some modified top loading Mark II's,* a second upper buckle-trip located above the upper twin rollers should be pushed *up*. Rotate upper and lower film-guide eccentrics away from the sprockets. 2. Rotate manual motor-turning knob until pulldown claw retracts from register plate (a back, upward stroke). Lift registration-pin throw-out knob *up* to retract pins from aperture plate. 3. Raise aperture-plate lock, remove aperture plate by pulling *gently*. If plate does not slide easily, check that pulldown claw and/or registration pins are clear of plate. 4. Clean plate and make a special check of pulldown claw and registration-pin holes for emulsion build-up or film chips, replace plate. Depress aperture-plate lock to secure. 5. Swing pressure-plate–spring arm clockwise. Remove pressure plate from register plate; clean. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to lower corner of camera (a rough guide for amount of film needed for threading).

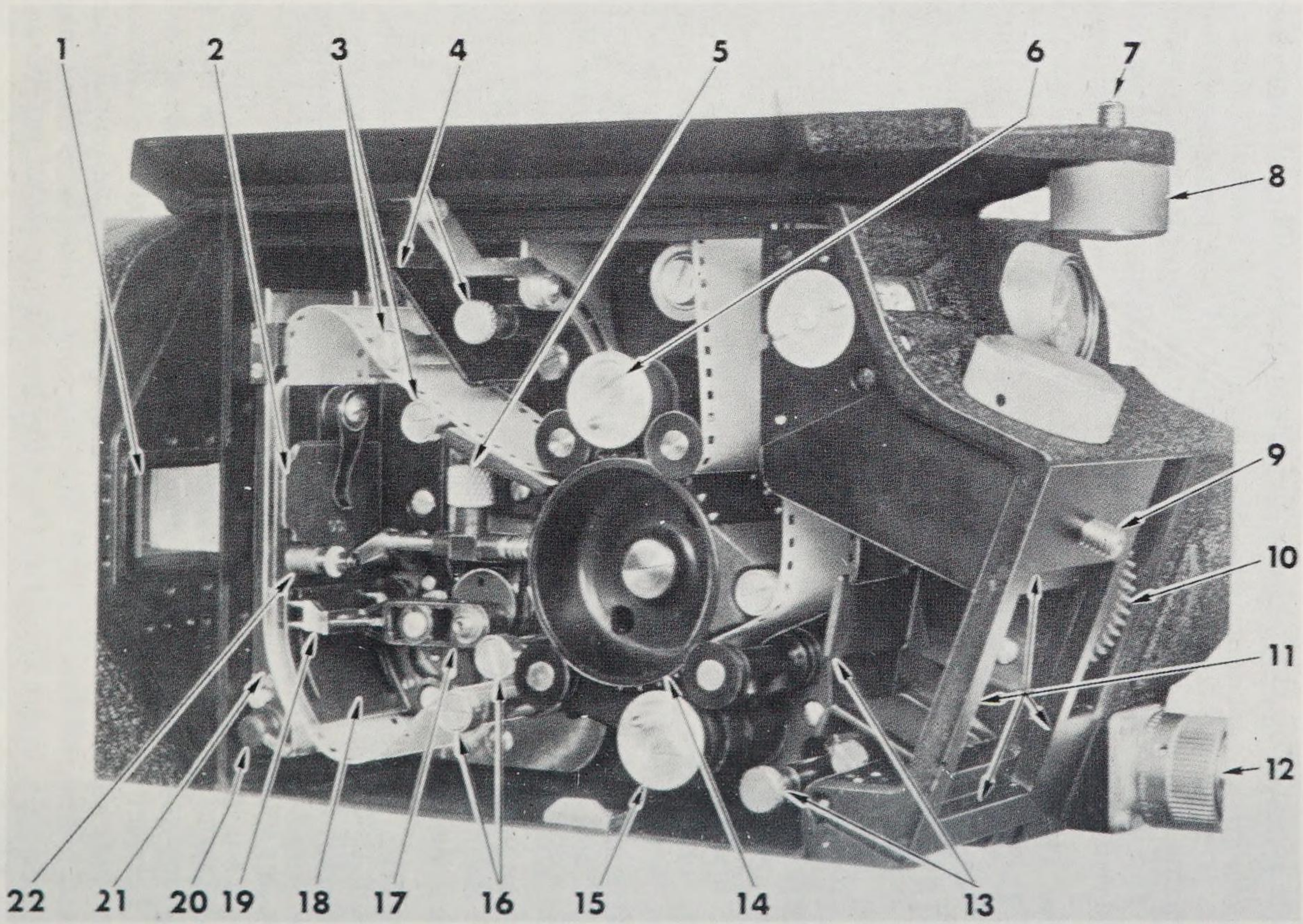
NOTE: The S35R and Mark II interiors are very compact. Film pulled from the magazine to form the loop may contact the camera interior, scraping emulsion from the raw-stock edges. Care should be exercised to prevent emulsion from dropping into the camera movement.

For inverted and slant-load magazines: 7. Starting clockwise from the magazine take-up side, insert film: (a) *Under* the buckle-trip roller and between lower film-guide eccentric and sprocket. (b) Between lower twin rollers (*under* top small roller and *over* lower small roller) located below pulldown arm. 8. Starting counterclockwise from magazine feed side, insert film: (a) *Over* the buckle-trip roller and between upper film-guide eccentric and sprocket. (b) Between upper twin rollers (*over* lower small roller and *under* top small roller) located above registration-pin throw-out knob. (c) In groove (the race) between the removable aperture plate and stationary register plate.

For top-load magazines: 7. Insert film clockwise from magazine take-up side: (a) To the right of buckle-trip roller, then between lower film-guide eccentric and sprocket. (b) Between lower twin rollers (*under* top small roller and *over* lower small roller). 8. Starting counterclockwise from magazine feed side, insert film: (a) Between upper film-guide eccentric and sprocket. (b) Between upper twin rollers (*below* top small roller and *under* lower small roller) located above

Fig. 16-17. Mitchell S35R threading detail (for top-mounted magazine). Courtesy of Mitchell Camera Corp.

1. Filter holder
2. Pressure plate
3. Upper twin rollers
4. Upper buckle-trip apron and reset knob
5. Registration pin throw-out knob
6. Upper film guide eccentric
7. Top-load magazine lock-down screw
8. Top-load magazine lock-down knob
9. Inverted magazine and cover plate lockdown screw
10. Camera drive gear (coverplate removed for illustration)
11. Camera-body guide grooves for magazine (coverplate removed)
12. Sync-generator connection
13. Lower buckle-trip apron and reset knob
14. Sprocket
15. Lower film-guide eccentric
16. Lower twin rollers
17. Sliding block
18. Register plate
19. Pulldown claw
20. Aperture plate locks
21. Aperture plate
22. Registration pins



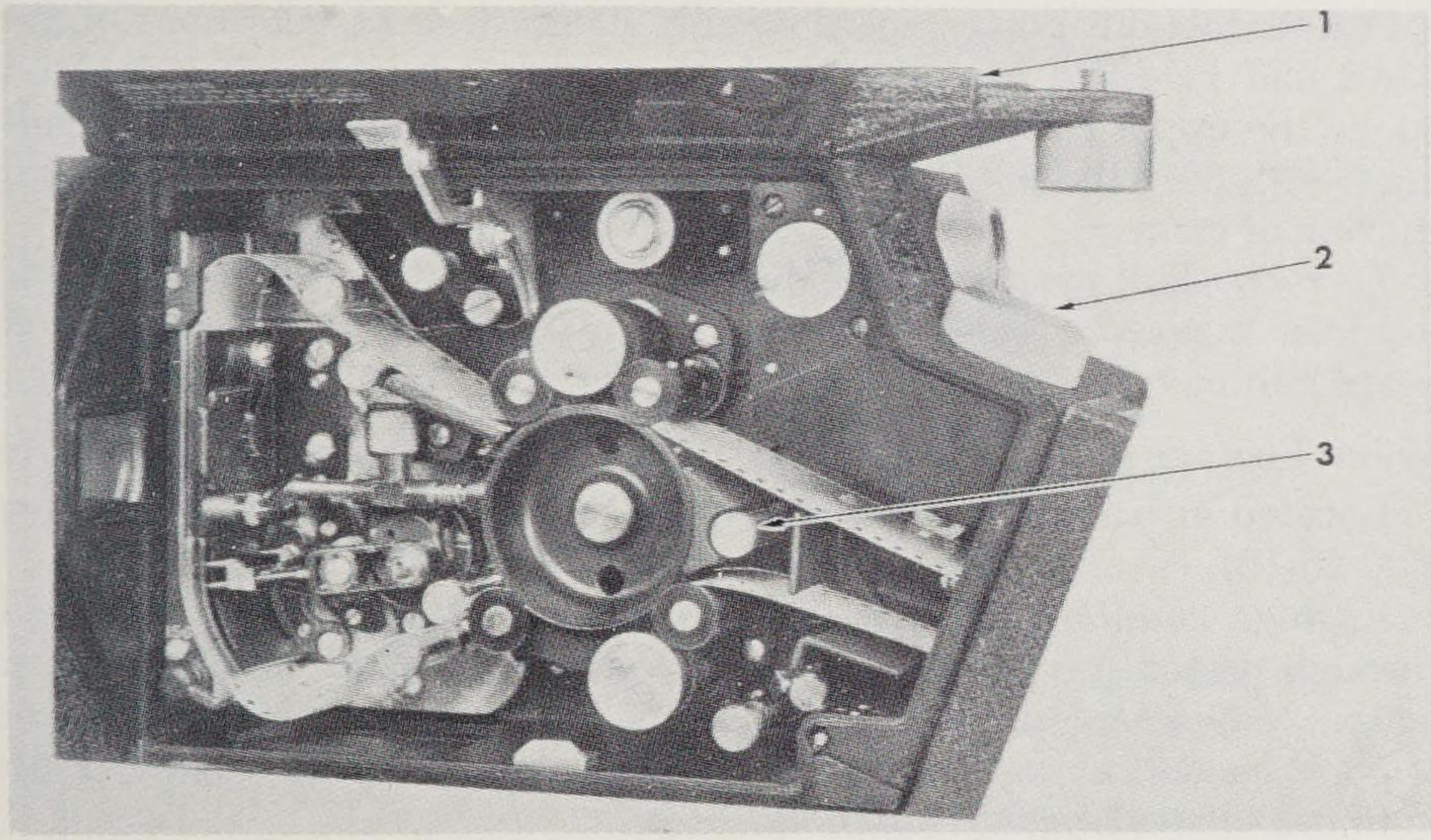


Fig. 16-18. Mitchell threading detail for slant-loaded and inverted magazines. Courtesy of Mitchell Camera Corp.

1. Top-load magazine guide-groove (shoe)
2. Inverted magazine lockdown knob
3. Buckle-trip roller

registration-pin throw-out knob. (c) In groove (race) between the removable aperture plate and stationary register plate.

9. Hold film in race. Rotate manual motor-turning knob (see Fig. 16-16) gently in reverse until pulldown claw engages perforations. Registration pin will drop in automatically with one full *forward rotation* of the manual motor-turning knob. 10. (a) Adjust lower loop so that when lower film-guide eccentric closes, loop will clear bottom of box by 1/16–1/8 in. at the lowest arc of loop. (b) Adjust upper loop so that when upper film-guide eccentric closes, arc of loop bisects second screw from top of aperture-plate–guide-rail bracket. 11. Rotate magazine take-up spindle wheel clockwise to take up film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel and subjects the belt to a minimum of stretching). 12. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 13. 13. Pull lower buckle-trip reset knob (below the buckle-trip apron). For top-load magazine, also pull top buckle-trip knob located above upper twin rollers. Hold pins on upper and lower film-guide eccentrics with thumb and forefinger.

CAUTION: Keep the knuckles of the hand clear of the movement! Apply power in short bursts and observe action of film. If satisfactory, stop camera, close door, and reset footage counter.

16.5n Buckle-trip

Apron (a curved metal plate), in camera behind take-up side of

sprocket, cuts out power automatically if film fails to take up. *On the S35R and modified top-load Mark II,* a second buckle-trip is located above the upper twin rollers. Power should be cut out prior to threading by tripping the apron toward rear of camera to prevent accidental starting of camera.

To reset: Pull reset knob below apron until unit snaps forward. For top-load magazines, also pull reset knob above top apron until unit snaps into place.

16.5o Footage and frame counters

Located at back of camera above the magazine lockdown knob (see Fig. 16-16).

Footage counter: Additive. Registers each foot of film transported through camera up to 999 ft, then reverts to zero and counts forward again. May be reset to zero each time magazine is changed. Reset knob is located at top left rear of camera door, above eyepiece. Push in to engage and change numbers.

Frame counter: Additive in increments of one up to 16 frames, then reverts to one. Frame counter *does* go back to zero when footage counter is zeroed. This is unlike any other Mitchell footage counter.

16.5p Tachometer

At top rear of camera. Registers speed from 0–128 fps in increments of 4 frames per second.

16.5q Shutter

Variable; 0–170°. Calibrations and external shutter control (see Fig. 16-16) are at top of camera (right side), forward of the bullseye bubble level.

To change shutter opening:

1. Loosen the two slotted knurled stops (one at each side) of the external control knob. 2. Depress control knob and move indicator to desired shutter opening; release. 3. Turn control knob clockwise to lock. As a safety precaution, slide the knurled stops against the front and rear of the control-knob block. Tighten both stops with screwdriver. 4. *On the S35R only,* the control knob can be turned an additional quarter of a turn counterclockwise to completely release the shutter control when installing the camera in a sound blimp (see Sec. 16.6).

16.5r Lubrication (Fig. 16-19)

Manufacturer recommends lubrication of the following parts every 20,000 ft with one or two drops of high-speed–camera oil when operating at 24 fps, or before every high-speed run:

Movement: Registration-pin bearing; spring-loaded registration-pin bearing and ball bearing, which is at back of registration-pin throw-out knob; rear bearing on pulldown claw arm; registration-pin cam; cam bearing; top and lower sides of sliding block; pressure-plate retainer arm.

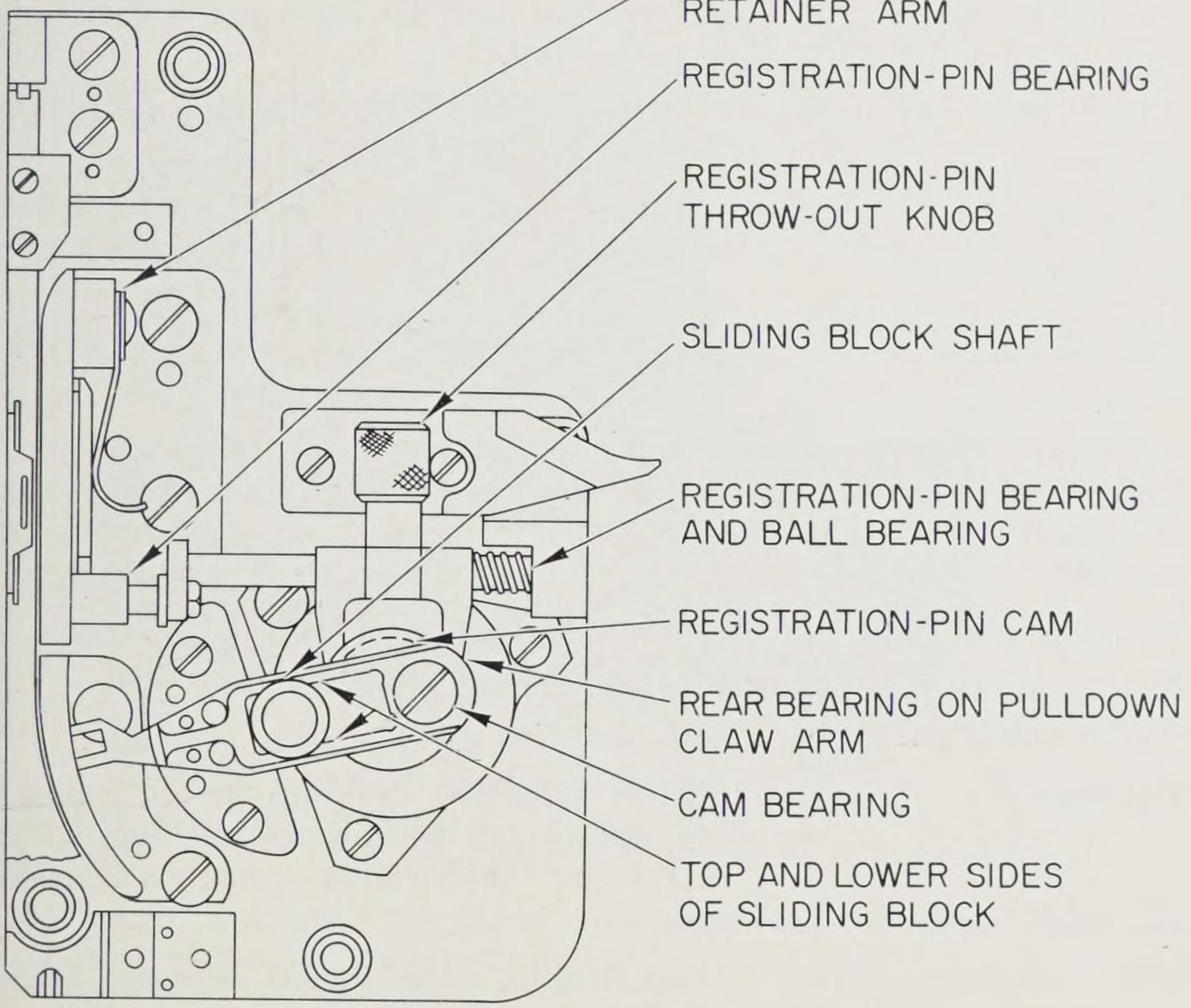


Fig. 16-19. Mitchell S35R movement lubrication points. Courtesy of Mitchell Camera Corp.

Rollers: Every 50,000 ft or before every high-speed run.

NOTE: After oiling, run camera to eliminate excess oil and wipe clean.

16.5s Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior.

16.5t Weight: (with 400-ft load) 39 lb; (with 1000-ft load) 43 lb.

16.5u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not set; power-line connection faulty; low temperature; thumb switch on the turret not forward

Trouble	*Probable Cause*
Camera "hunts"	Camera not warmed up; voltage variation in power line
Camera door will not close	Film-guide eccentrics not seated properly; film chip or dirt in door
Film jam	Improper threading; magazine covers not relieved on "dished" roll; take-up belt not on
Lens will not focus	Mount not seated properly; turret not seated properly; lens damaged
Cammed or noncammed offset viewfinder does not match reflex-tube cross hair	Turret not seated properly; offset-viewfinder parallax not set; offset viewfinder not seated in dovetail bracket; wrong cam on finder; wrong lens on front of viewfinder
Film will not slide in race	Registration pin or pulldown claw not retracted; emulsion or film chip in race
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up in the following: aperture or pressure plates; film-guide eccentrics; registration pins; magazine rollers
Reflex viewing tube blurred	Magnification knob seated between magnifying position (HI) and normal position (LO)
No take-up, or sporadic take-up	Belt either slipping or too loose
Cut-in on reflex tube	Shutter not clear of reflex mirror; turret not seated; matte box extended; internal filter holder not seated; matte forward of groundglass not seated
Light trap will not close	Eyepiece inserted too far into focusing tube

16.5v S35R/Mark II magazine-loading instructions: see Sec. 16.2.

16.6 MITCHELL S35R BLIMP (Figs. 16-20, 16-21)

NOTE: All directions are from the Operator's point of view.

NOTE: (a) The blimp requires a special S35R riser (not shown) when used on a geared head. (b) The blimp only accepts an S35R camera with a top-load magazine.

16.6a Base

Bottom fitted with one ⅜"-16 tapped hole to accommodate tripod locking screw.

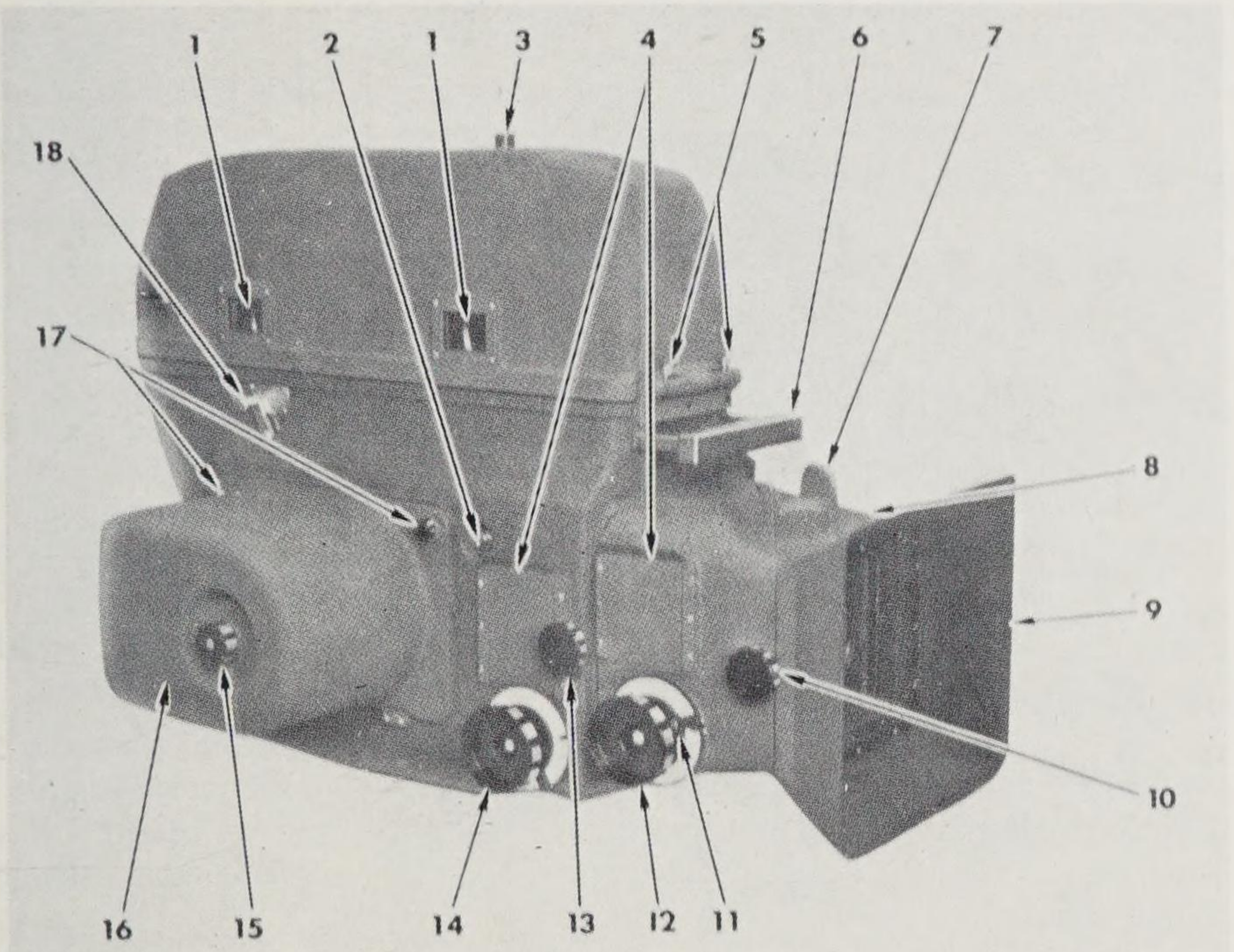


Fig. 16-20. Mitchell S35R blimp with zoom lens extension (right side). Courtesy of Mitchell Camera Corp.

1. Magazine spindle-wheel viewing ports
2. Internal light switch
3. Tally light
4. Lens-viewing–window covers
5. Hood-hinge pin knobs
6. Carrying handle
7. Lightshade bracket
8. Zoom housing (snout) front door assembly (optional)
9. Matte box
10. Front door lock knob
11. Focus lock knob
12. Zoom focus knob
13. Lens access or zoom door lock knob
14. Standard follow-focus knob or zoom focal length drive
15. Manual motor-turning knob
16. Motor-cover housing
17. Motor-cover housing attaching screws
18. Shutter dissolve control handle

16.6b Blimp hood

Mounts *before* magazine is installed on blimped camera. When blimp hood (magazine-housing cover) is separate from the blimp:

To mount:

1. Squeeze retractable hood hinge-pin knobs at front of blimp hood (shown) and insert hood-hinge knuckle into hinge leaves. Release hinge pins to secure hood to blimp. 2. Raise rear of hood. Remove keyed pin from yoke (not shown) in blimp hood and insert shock-absorber arm into yoke (not shown). Insert keyed pin onto yoke through shock-absorber arm. To lock, rotate keyed pin.

CAUTION: Pin is inserted into yoke only one way. It must be seated and rotated to lock. Once rotated, pull pin to be sure it is secure. When properly installed, the shock absorber will prevent the hood

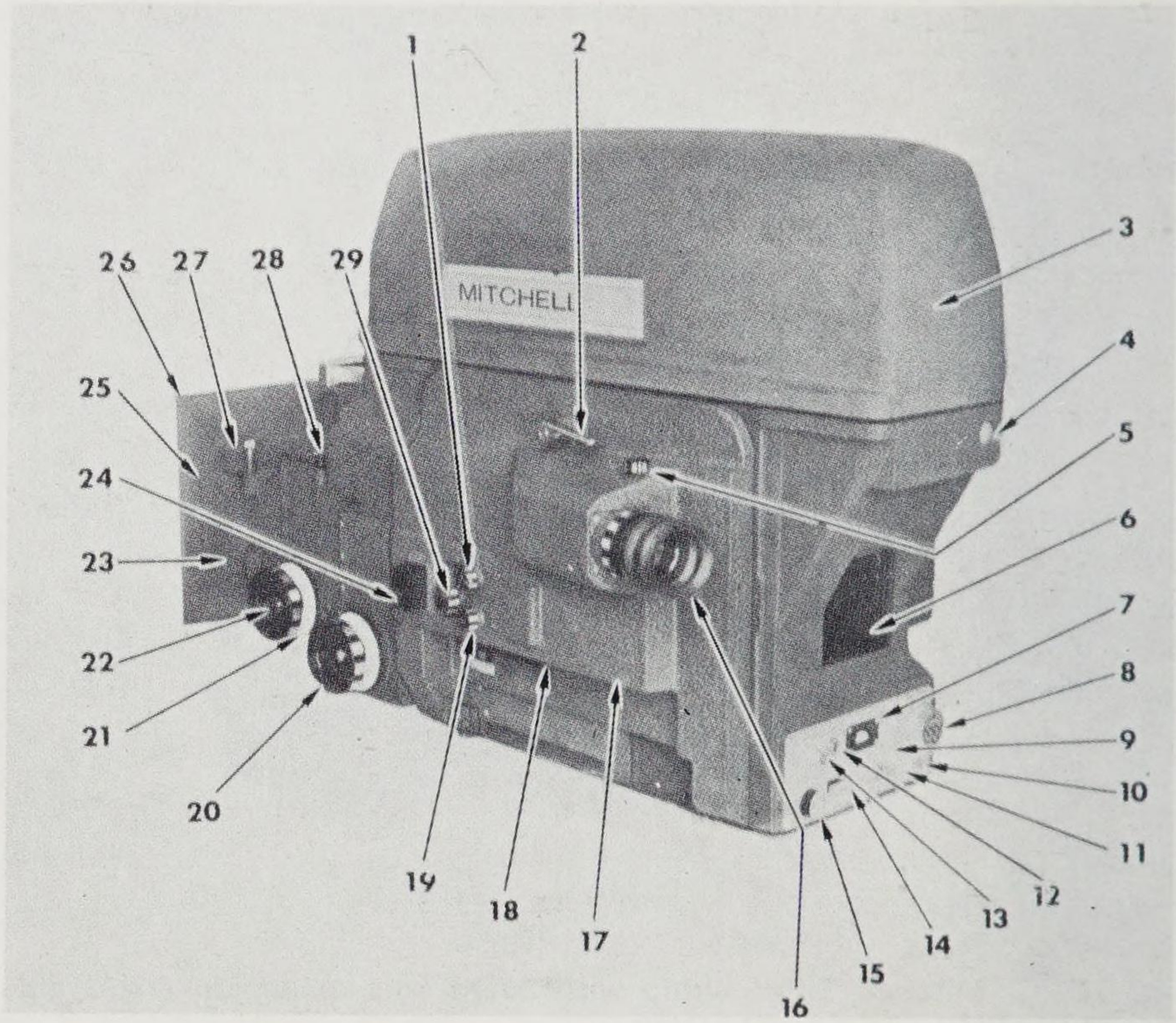


Fig. 16-21. Mitchell S35R blimp with zoom lens extension (left side). Courtesy of Mitchell Camera Corp.

1. Color filter knob
2. Focus tube door latch
3. Blimp hood
4. Hood latch button
5. Light trap knob
6. Tachometer/counter port
7. Spirit level
8. Remote console plug (optional)
9. Control panel
10. Power-line plug
11. Power selection toggle switch
12. Phone jack
13. Zoom control Cannon plug accessory
14. ON/OFF switch
15. Fuse
16. Eyepiece
17. Focus tube door
18. Bracket for worm gear fits here
19. Black-and-white filter knob
20. Standard lens follow-focus knob or zoom focal-length knob
21. Marking disc
22. Adjusting knob
23. Cutout cover plate
24. Offset-viewfinder bracket
25. Thumb-lock pins
26. Front door assembly
27. Zoom housing brackets
28. Blimp brackets
29. Hi/Lo magnification knob

from dropping unexpectedly and will allow hood to remain in any desired open position.

16.6c Front door

Unit is inserted between the blimp brackets. Two slotted holding pins, threaded at the shoulder of the shanks, screw into the top and bottom brackets to secure the door to the blimp.

NOTE: When using an offset viewfinder on the blimp, unscrew thumb-lock pins (see Fig. 16-21) and remove cutout cover plate on left side of the matte box to obtain clearance for viewfinder optics.

Varifocal-lens (zoom-lens) extension housing (See Figs. 16-20 and 16-21):

To mount: Insert housing between blimp brackets. Insert straight front-door hinge pins into mounting holes.

To remove: Depress button on front-door hinge pin, pull up to remove top pin; pull down to remove bottom pin.

NOTE: (a) Pins can be pulled out but remain "captive" until a button in the head of the pin is depressed which causes safety catches to recede into the pin shank. (b) The front door (see Fig. 16-20) mounts onto zoom extension housing the same as it does on blimp. (c) When extension is mounted, the front-door lock becomes the zoom-door lock. (d) Focus lock knob on the scalloped zoom focus knob (Fig. 16-20) locks the mechanical stops on the follow-focus shaft. (e) Front-door glass has a multilayer antireflectance coating. (An optical flat glass is no substitute, since it is not coated.)

16.6d Motor cover

Attaches to right side of blimp. Cover is mounted *after* the camera is inserted into blimp.

To mount: Slide bottom lip of cover into two upright supports; secure two knurled attaching screws at cover top into tapped holes in blimp.

16.6e Camera preparation

Magazine: Remove from camera.

Eyepiece: Remove by loosening four screws holding eyepiece to the door. Replace with blimp eyepiece adapter found in blimp accessory case.

Lenses: When used in a blimp, camera requires lenses fitted with focus lens-gear-rings. (T stops are set manually.)

Motor: Removal is optional before insertion of camera into blimp.

CAUTION: Voltage and phase of motor must be checked for agreement with the voltage switch on panel at the back of blimp (120V single-phase; 208–220V single- or three-phase). When the switch has been set, tape the switch down so that it cannot be changed accidentally.

Shutter: Rotate camera shutter-control knob counterclockwise until it stops; depress knob and rotate counterclockwise one more quarter-turn.

CAUTION: The shutter opening on the camera must be checked after installation for agreement with the shutter control setting on blimp. (See "Shutter" in Sec. 16.6j.)

16.6f Access

To magazine: Depress hood-latch button at back of blimp (see Fig. 16-21) (top right). The hood, hinged at front, lifts up and away from Operator.

To lenses: Rotate small lens access knob above follow-focus knob (Fig. 16-20) (at right side) counterclockwise. Open door, and swing it to the left.

To motor: Rotate the two knurled screws on motor cover (Fig. 16-20) counterclockwise. Lift cover from holding lugs.

To camera: Turn latch on blimp focus-tube door (Fig. 16-21) counterclockwise and allow blimp door to hinge downward.

16.6g Camera insertion

1. Unscrew gear location knob (see Fig. 16-22) inside lens access door. Push knob up to move the coupling gear away from the lens gear area. Tighten gear location-knob. 2. Slide camera through blimp focus-tube door. Place the front ⅜"-16 tapped hole of camera on the locating stud in the blimp base plate. Place rear of camera in the trough that accommodates the camera body. Slide camera until the spring-loaded lockdown screw in base plate inserts into rear tapped hole. 3. Rotate offset knob at rear of plate until the ⅜"-16 lockdown screw locks camera to plate.

16.6h Power line

External: A four-pin Cannon plug (at lower right of panel at back of blimp) accepts the power line.

Power panel: Located at back of blimp (see Fig. 16-21).

Top row, left to right: Zoom control Cannon-plug receptacle (the FWD, REV, and Speed-Control Box attaches to the left top of blimp); phone jack; spirit level; 20-pin Cannon remote-console plug, which is used in conjunction with a multiple camera setup or a vidicon system and remote television console (i.e., Operator views through a television monitor instead of a standard Mitchell viewfinder).

NOTE: A blimp intended strictly for single camera filming will not have the 20-pin Cannon plug.

Bottom row, left to right: Fuse (illuminates when it blows out and remains illuminated until replaced); motor ON/OFF switch (glows white to indicate there is power to the camera, glows red when the motor is running); power-selection toggle switch (*up* for 208–220V, single-to three-phase; *down* for 110V, single-phase—this switch must correspond to the voltage and phase of the motor being used on the camera); camera power-line Cannon plug.

Internal: Single three-pin Cannon plug (not shown), located at the back below tachometer viewing port, is inserted into camera motor receptacle. Sync-pulse plug (not shown), located at back below the tachometer viewing port, is inserted into camera sync-pulse receptacle.

16.6i Internal lights

Toggle switch for internal lights (see Fig. 16-20) is located at right side of blimp exterior above the focus knob. Switch activates all lights and works off the AC line, not a battery as found on other blimps. Two adjustable lens lights inside the blimp (Fig. 16-22) illuminate the taking-lens barrel.

An adjustable rear light (not shown) illuminates the tachometer and footage counter.

NOTE: (a) Manufacturer states that lamps can be left burning during filming, since lamps are shielded. However, lamps (especially the rear light) should be checked to be certain that light does not hit the rear of the front-door glass. Although the glass is coated, and skip light does not reflect, if the rear lightbulb is accidentally aimed at the glass, the direct beam could cause a flare and "kick back" into the lens. (b) *When using a zoom-extension housing:* The Cannon plug that provides AC to the two zoom-lens lights (which are permanently affixed inside the extension housing) must be coupled to the four-pin female Cannon-plug receptacle (located directly above the coupling gear) to illuminate the taking-lens barrel. (This receptacle is not used when standard lenses are mounted in the blimp.) (c) The talley light (red light at top of blimp hood) is illuminated only when camera is running. It must be coupled internally with the four-pin Cannon plug located above and opposite the lens-coupling gear. (d) On both the zoom-extension–light plug (located directly above the coupling gear) and the tally-light plug (located opposite the zoom-extension plug): clockwise from each plug key, pins no. 1 and no. 2 are AC lines.

16.6j Coupling alignment (Fig. 16-22)

Standard lens:

1. Rotate lens access (or zoom-door) lock knob (at right side of blimp, see Fig. 16-20) and swing front door open. 2. Unscrew knurled gear-location knob (see Fig. 16-22) counterclockwise and push knob down to move coupling gear away from lens gear; insert lens into port. 3. Rotate scalloped standard lens follow-focus knob (located at both sides, lower front of blimp, Figs. 16-20 and 16-21) counterclockwise until it is as far back (toward Operator) as it will go. On units with a worm gear mounted below the focus-tube door, rotate knob counterclockwise until the cam roller is as far back as it will go. 4. Set lens at infinity, or slightly beyond if gear teeth of lens will not mesh with coupling gear precisely at infinity. 5. Push gear-location knob up and engage coupling gear into teeth of lens gear; tighten clockwise the knurled gear-location knob. 6. Make a penciled infinity mark (∞) on the white disc behind the follow-focus knob for a constant reference. 7. Set T stop manually, close front door. If using an offset viewfinder (see Sec. 16.6l) place cam that corresponds to the taking lens on the viewfinder.

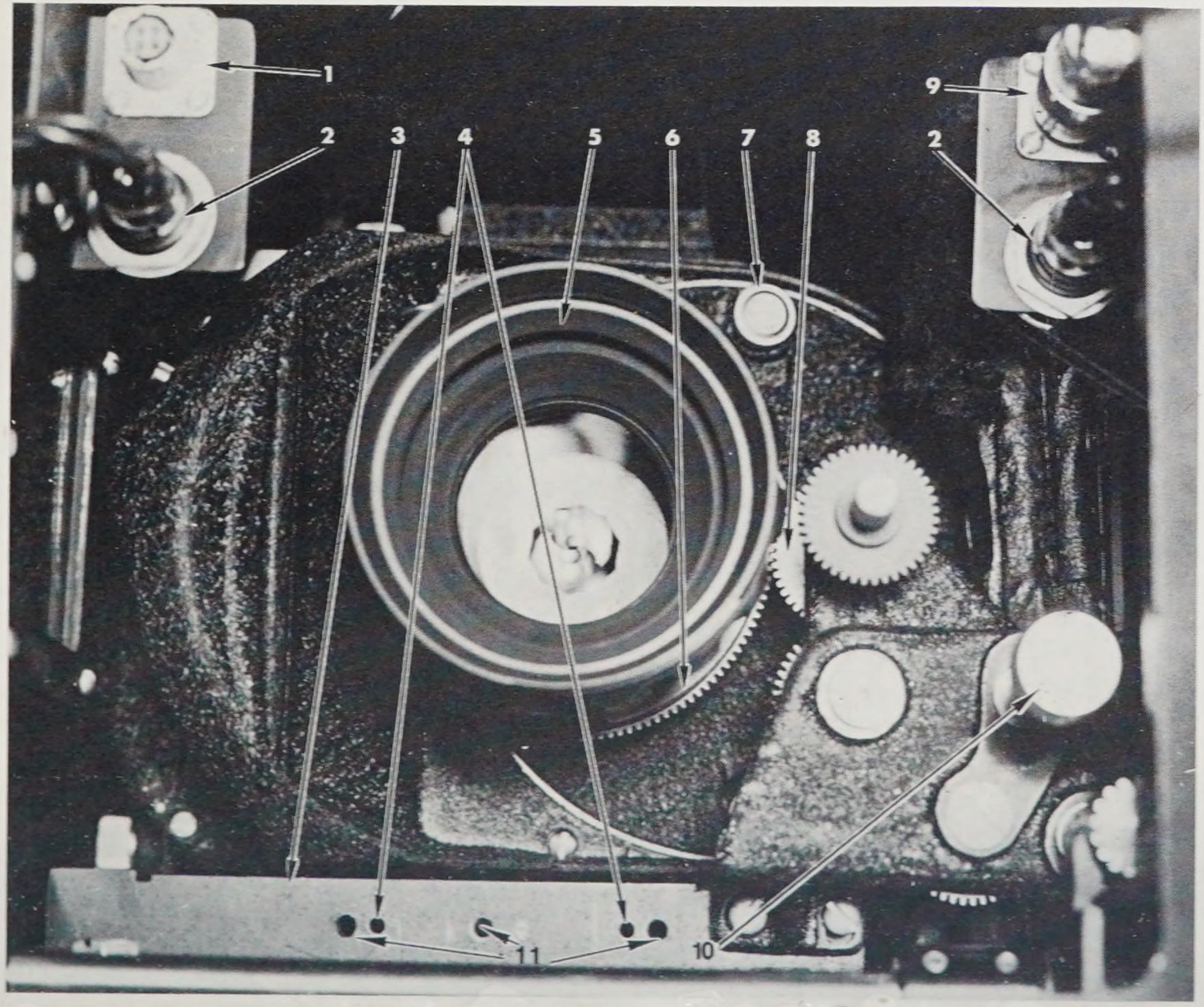
Varifocal (zoom) lens (also see Sec. 16.6c): Place zoom-extension housing on front of blimp (see Figs. 16-20 and 16-21):

To align manual zoom:

1. Open (lens access or) zoom-door lock knob (see Fig. 16-20) and swing extension housing away from blimp. Rotate knurled gear-location knob inside the blimp counterclockwise, push knob down and move the coupling gear away from the lens gear. 2. Align the horizontal support arm (see Fig. 16-23) (an accessory) with the front of the camera base plate inside the blimp. Two locating pins at each side of the single thumbscrew on the support arm insert into mating register holes and a single tapped hole in the base plate (see Fig.

Fig. 16-22. Mitchell S35R blimp (lens coupling detail). Courtesy of Mitchell Camera Corp.

1. Tally light and/or zoom motor plug
2. Adjustable lens lights
3. Camera base plate
4. Register holes for horizontal support arm (see Fig. 16-23)
5. S35R geared lens
6. Geared lens ring
7. Turret lock
8. Coupling gear
9. Zoom extension light plug
10. Gear location knob
11. Tapped holes



16-22); secure. Adjust horizontal support knob until support arm is level to camera base. 3. Insert zoom lens into turret port (see Sec. 16.5h for proper method of lens insertion). 4. Place vertical support arm (zoom-lens cradle) under lens. Align pilot hole at base of vertical arm with tapped hole at end of horizontal support arm. Secure with vertical arm lock knob. Adjust bottom circular clamp-support ring to lens. 5. Fasten zoom lens to vertical bracket by securing the top circular clamp-support ring to the bottom support ring. 6. Set lens at longest focal length. Push gear-location knob up and engage coupling gear into teeth of geared focal-length ring. Tighten gear-location knob. Pencil in all focal lengths of lens scale on to the white disc behind the zoom focal-length knob. 7. Set zoom lens to infinity (∞) (or slightly beyond if gear teeth will not mesh precisely at infinity).

WARNING: *Before closing the zoom-extension housing,* ALWAYS screw in the adjusting knob located in the left zoom focus knob (see Fig. 16-21) of the zoom-extension housing. Close zoom-extension housing and lock it.

8. Rotate front-door lock knob on right side of zoom-extension housing (see Fig. 16-20) and swing the front door open. 9. Release adjusting knob and ascertain that the spiral teeth of the zoom focus knob-gear properly engages the teeth of the focus ring on the lens.

WARNING: *Before opening the zoom-extension housing,* ALWAYS set the lens focus at infinity and screw in the adjusting knob to clear the spiral zoom focus knob-gear from the geared focus ring on the lens.

Make a penciled infinity mark (∞) on the white disc behind the zoom focus knob for a constant reference.

Set T stops and *f*/stops manually.

Close front door and lock it.

Zoom-lens: motorized: Follow steps 1–4 as above, then: 5. Loosen gear-location knob; push knob down to disengage the coupling gear from the focal-length geared ring on the lens. Tighten the gear-location knob. Set lens at its longest focal length. 6. Engage zoom-motor gears to the focal-length gear ring by securing the top circular clamp-support ring and its motor bracket to the bottom ring.

NOTE: The focal-length ring is fitted with adjustable stops so as to limit the zoom travel within a preselected range.

7. Insert the zoom-motor–extension Cannon plug into the upper right female Cannon receptacle (the tally-light receptacle) (see Fig. 16-22). 8. Insert the zoom remote-control extension into power panel at rear of blimp (see "Power panel" in Sec. 16.6h and Fig. 16-21). The zoom remote-control unit is fitted with FWD/REV buttons and a speed-control rheostat.

Shutter

To align blimp shutter-control–arm knob to camera shutter:

1. Make certain that adjustable shutter-control knob on camera (see Figs. 16-15 and 16-16) is rotated counterclockwise until it stops; then

depress and rotate knob counterclockwise one more quarter-turn. Shutter should slide free in its restricted slot without interference. Set shutter indicator on camera to 170°. 2. Pull lock pin on shutter control handle (at right side of blimp above motor cover) (see Fig. 16-20) and set shutter indicator at 170°. 3. Align screw on shutter arm (which is internally coupled to the external handle) (not shown) with the top of the camera shutter knob. 4. Hold knurled shutter knob on camera to prevent it from rotating and locking the shutter down. Insert the screw on the internal shutter arm into tapped hole on top of the knurled shutter knob; secure. 5. Pull lock pin and move shutter-control handle (Fig. 16-20) to verify that shutter opens and closes.

CAUTION: Check all shutter settings on the camera scale (see Fig. 16-16) for agreement with shutter settings on the blimp scale (at the shutter control handle, see Fig. 16-20).

When blimp and camera shutter settings do not agree:

1. Leave shutter screw-on–arm extension (not shown) coupled to knurled shutter knob on camera. 2. Loosen set screws holding shutter dissolve bracket (not shown) to shutter arm; loosen bracket. 3. Set shutter-control handle (Fig. 16-20) at 170°. Set camera shutter (Figs. 16-15 and 16-16) indicator at 170°. 4. Tighten set screws securely. Place blimp shutter-control handle at various shutter settings and compare camera shutter indicator for agreement.

16.6k Filters

To mount internal holder:

1. Align filter horizontal support arm with front of camera base plate. Two locating pins, one at each side of a single thumbscrew on the support arm, insert into two mating register holes and tapped hole in the base plate; secure. 2. Adjustable U-shaped bracket accommodates glass filters in sizes 3 × 3 in. to 5 × 5 in. Filter unit fits to the horizontal support arm which slides in and out.

To mount filter: Insert square glass filter into U-bracket. Slide filter toward lens. Verify that filter covers *all* of lens; secure in place.

Circular glass filters can be inserted in lenses, or gelatine can be inserted in filter slot of camera (see Sec. 16.5j).

16.6l Viewfinder/focus tube: Reflex. In blimp door (see Fig. 16-21.)

To align reflex mirror for viewing: Depress manual motor-turning knob on motor cover (right side of blimp–Fig. 16-21) and rotate.

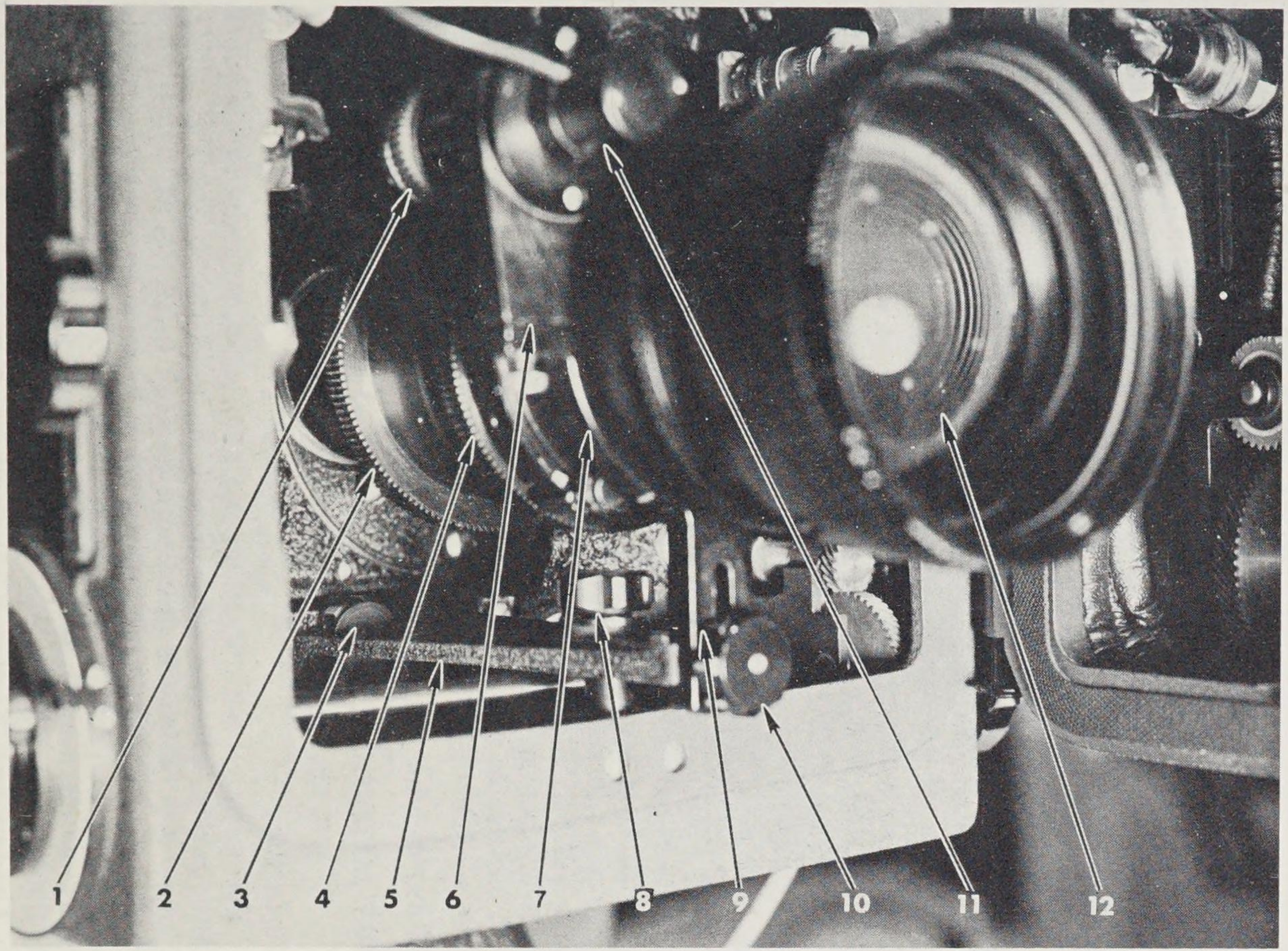
Eyepiece: Slides in and out; adjusts to achieve focus on groundglass. Knurled ring locks eyepiece at individual's focus.

Light trap control: Horizontal knob above eyepiece. Depress and rotate to close viewing system. Should be closed when offset viewfinder is used in place of reflex system.

Magnification control: The center knob closest to the offset-viewfinder bracket. Depress and rotate counterclockwise (HI) to magnify image 10×; rotate clockwise (LO) for normal viewing to magnify image 5×.

Fig. 16-23. Mitchell motorized zoom and bracket detail. Courtesy of Mitchell Camera Corp.

1. Zoom-motor drive gear
2. Geared focal-length ring (manual)
3. Single thumbscrew
4. Geared focal-length ring (motor)
5. Horizontal support arm
6. Motor bracket
7. Bottom clamp support ring
8. Horizontal support knob
9. Vertical support arm
10. Vertical arm lock knob
11. Zoom motor
12. Zoom lens



Contrast filters: Two. Control is vertically positioned behind magnification knob. Depress upper knob and rotate to flip filter into view for color film. Depress lower knob and rotate to flip pan filter into view for black-and-white film.

Offset viewfinder: Unit is inserted into bracket located forward of magnification and contrast-filter knobs. Three types of offset viewfinders are available:

1. BNC-type with cams and automatic focus capability (see Sec. 16.4j).

   NOTE: An S35R blimp must be fitted with a cam bracket and worm gear for use with a BNC-type viewfinder.

2. NC-type with manual setting of focus and parallax (see Sec. 16.3h).
3. Frame-type (tracking finder, not shown) with transparent colored mattes for change of field size.

   CAUTION: The tracking finder is only usable with lenses 50mm or longer.

16.6m Ports

Window at back of blimp allows viewing of tachometer and footage counter. Lens-viewing windows are located at each side of blimp front and/or zoom-extension housing; each lens-viewing window is fitted with vertical sliding covers to prevent stray light from striking the interior of blimp lens area.

Windows in the hood allow viewing of the magazine take-up and feed spindle wheels.

16.6n Weight: (less camera) 93 lb.

16.7 MITCHELL 16 PRO AND HS CAMERAS* (Figs. 16-24, 16-25)

NOTE: All directions are from the Operator's point of view.

16.7a Base

Bottom fitted with ⅜"-16 tapped hole to accommodate tripod lock-down screw. The base is L-shaped; includes turret (see Fig. 16-24). Flat section of base is fitted with dovetail tracks (gibs), which allow the camera to slide (rackover) horizontally to align the focusing tube with the taking lens. A dovetailed viewfinder bracket, into which the offset viewfinder is inserted, is an integral part of the upright section of the base.

The Mitchell 16 does *not* have four-way mattes.

16.7b Rackover

Camera box must be racked over (i.e., moved laterally on gibs until focusing tube is directly behind taking lens) to sight through the taking lens.

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*The Mitchell 16 PRO (Professional) and the Mitchell 16 HS (High Speed) cameras are basically the same design. The immediately apparent difference between the PRO and HS is in the shutter (see Sec. 16.7q), and, in some instances, in the turret (See Sec. 16.7f).

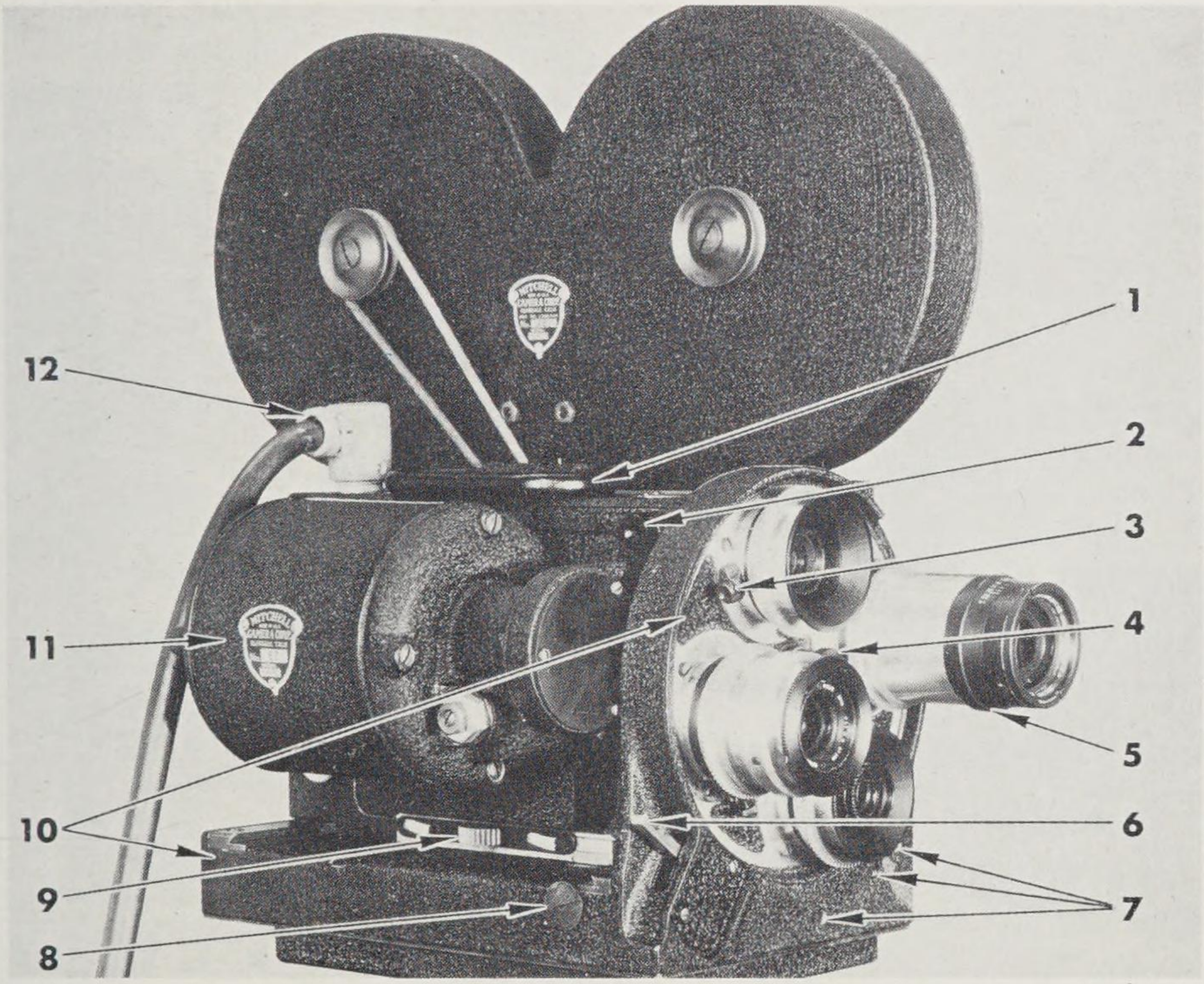


Fig. 16-24. Mitchell 16 with matte box removed (right front view). Courtesy of Mitchell Camera Corp.

1. Carrying handle
2. Forward motor screw
3. Lens-focus lockdown screw
4. Turret-locking knob (partially obscured)
5. Taking lens position
6. Turret-release lever
7. Sunshade-bracket holes
8. Rackover stop
9. Motor door latch
10. Base and thrust
11. Synchronous motor
12. Power-line plug

To rack over:

1. Grasp handle at rear of camera (see Fig. 16-25) and depress button to release locating plunger. 2. Start to rotate handle clockwise and *release button immediately* so that the locating plunger can engage the camera box.

CAUTION: Some cameras are *not* equipped with stops to prevent excessive lateral movement of the camera box. Therefore, unless the button is released immediately, the camera can be racked completely off the base.

3. Rotate handle counterclockwise only to check that plunger has engaged the camera box and that the focusing tube is aligned with the taking lens.

NOTE: A microswitch cuts off power to the camera when it is racked over; camera will not run until it is racked back to shooting position.

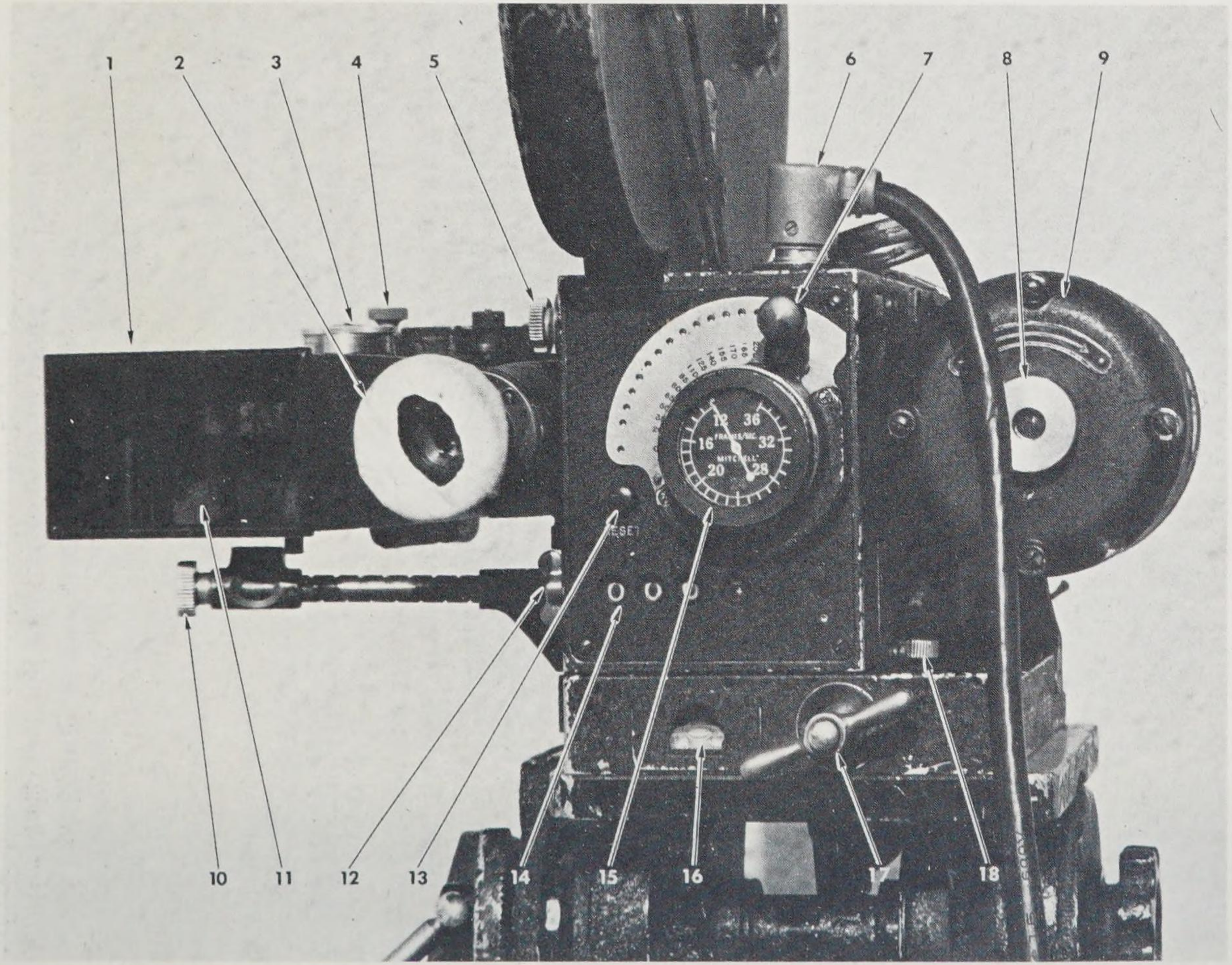


Fig. 16-25. Mitchell 16 (rear view). Courtesy of Mitchell Camera Corp.

1. Horizontal matte-adjusting knob (not visible, see Fig. 16-41)
2. Focusing tube eyepiece (with chamois eye-guard)
3. Viewfinder matte-adjusting knob
4. Viewfinder parallax-locking screw
5. Magazine lockdown knob
6. Power-line plug
7. Shutter handle
8. Manual motor-turning knob
9. 110V sync motor
10. Parallax-adjustment screw (accessory)
11. Offset viewfinder
12. Counter reset knob
13. Buckle-trip reset button
14. Footage and frame counter
15. Tachometer
16. Bubble level
17. Rackover handle
18. Motor door latch

To rack back:

1. Depress button and start to rotate handle counterclockwise. *Release button immediately* so that the locating plunger can engage the camera box. 2. Rotate handle clockwise only to check that locating plunger has engaged the camera box and that the aperture is aligned with the taking lens.

16.7c Focusing tube: Located in camera-box door. (see Fig. 16-42)

To change or clean groundglass:

1. Slide access door (at side of focusing tube) (see Fig. 16-42) toward Operator, open camera door, and insert eraser end of pencil into forward opening of tube. 2. Slide groundglass sideways; grasp glass by edges and remove; clean and reinsert; close access door.

NOTE: *ALWAYS* insert groundglass with smooth surface toward rear of tube.

Matte slot: None.

Effects matte: No provision.

Magnification: Push magnification knob (located below focusing tube) forward to magnify 10×; push back for normal image.

Contrast filters (see Fig. 16-42): Two. Knurled knob at top rear flips green filter into view for orthochromatic film. Bottom-rear knob flips pan filter into view for panchromatic film.

Eyepiece (see Figs. 16-25 and 16-41): Rotates; moves in and out; adjusts to achieve focus on groundglass. Locking screw holds eyepiece at desired focus.

16.7d Motors

NOTE: *Synchronous motors* (see Fig. 16-24) have manual turning knob (see Fig. 16-25) located at the back.

Variable-speed motors (not shown) have the manual turning knob at the right side, the speed-control rheostat at the back, and the FWD/REV switch at the side.

High-speed motors (not shown) have the manual turning knob at the right side, the speed-control rheostat at the back, and the high-speed tachometer at the top. Some models may have a FWD/REV switch, but it is not standard.

To mount synchronous, variable-speed, or high-speed motor:

1. Make certain that motor door latch, at right side of camera base, is pushed all the way forward. 2. Rotate manual motor-turning knob until drive coupling aligns with movement drive shaft in camera, and four-pin Cannon-motor plug aligns with camera receptacle. Fit motor against camera. 3. Slide motor door latch, at base, toward rear of camera. Secure two knurled screws on motor to tapped holes in camera.

To reverse variable-speed motor: (Also high-speed motor if fitted with reverse switch).

1. Turn motor switch to "REV." 2. Transfer belt from take-up to feed spindle wheel. Loop the belt in a "figure 8"; this will cause feed to act as "take-up"; adjust motor speed.

CAUTION: Cover lens or close shutter when running film back to beginning of scene intended for double exposure.

The following motors are available for the Mitchell 16 PRO and HS:

Variable-speed motor: 12V DC; 110V AC/DC (60 Hz); 110V AC/DC (50 Hz).

Slow motion motor: 24V DC (16–64 fps); 110V AC/DC (60 Hz) (48–128 fps); 110V AC/DC (50 Hz) (48–128 fps).

High-speed motor: 115V AC (60 Hz) (12–400 fps); 115V AC (50 Hz) (12–400 fps).

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase); 220V AC (60 Hz) (3-phase); 220V AC (50 Hz) (3-phase).

Multi-duty motor: 220V AC (60 Hz) (3-phase)/96V DC.

NOTE: Multi-Duty motor is only synchronous at 220V AC (60 Hz).

CAUTION: *Never* run a Mitchell 16 PRO at a speed greater than 128 fps! The Mitcthell 16 HS may be run at speeds up to 400 fps.

16.7e Power line

Insert power-line plug (see Figs. 16-24 and 16-25) into four-pin receptacle at the top-rear of camera.

Variable-speed and/or high-speed motors have ON/OFF switch in cable. A 110V synchronous motor requires a capacitor box in the cable. ON/OFF switch is in the capacitor box.

16.7f Turret: Four-position (see Fig. 16-24).

To rotate: (Some, but not all, HS (high-speed) cameras are fitted with only a single lens, nonrotating turret). Depress turret-release lever (lower right side), turn turret until desired lens is in position at right of viewfinder bracket. Release lever to lock turret.

NOTE: (a) Center turret-locking knob may be tightened to hold a heavy telephoto lens. Ideal tension for normal operation is obtained by tightening the knob by hand and backing it off a quarter-turn. (b) The longest lens on the turret should be mounted opposite the shortest lens. (c) On some models, one port is fitted with "quick-set locks" (not shown), i.e., clamps which grasp the lens mount shoulder. These clamps are placed above and below the lens port and are loosened with a screwdriver. Quick-set locks permit efficient mounting and dismounting of a variety of lenses.

An easy method for mounting a lens using quick-set locks:

1. Rotate the turret until quick-set locks are at the top. Slide the clamps aside horizontally, insert new lens mount (cutoff portion of lens-mount shoulder aligns with perimeter of turret). 2. Slide the clamps back over the shoulder of the mount and tighten. 3. Rotate turret to place the lens in taking position.

NOTE: The lens *can* be mounted without rotating the turret. However, the upper quick-set lock drops down behind the lens mount shoulder in this position, making it more difficult to slide the mount into the port. The safety of the lens must always be considered. The

possibility of dropping the lens while "fighting" the top lock is increased if the turret is not rotated.

There is *no* turret-setting knob on the Mitchell 16.

16.7g Lenses

To fit lens to turret:

1. Unscrew lens barrel from threaded Mitchell Mount. Align screw holes of mount with tapped holes in turret, and secure with screws. 2. Insert lens barrel into threaded mount.

NOTE: (a) Rear element of 15mm lens extends into camera aperture when seated, therefore this lens must be backed off prior to rotating the turret. (b) Each mount is fitted with a focus lockdown screw.

16.7h Viewfinder

Offset (see Sec. 16.11b, Fig. 16-36). Fits and locks into dovetailed bracket at left side of camera base (see Fig. 16-42).

Ribbon-matte–adjusting knobs: Located at top and left side of finder, scribed to indicate various focal-length settings: *Wide-angle lens* (15mm) is scribed in red. *Normal and long lenses* are scribed in black.

Knobs may be set to two different indicators: projector or TV, but TV indicators are not standard equipment on Mitchell 16.

Top knob adjusts vertical ribbon mattes (frame side). Side knob adjusts horizontal ribbon mattes (frame top and bottom).

When using a 15mm lens, remove the circular sunshade at the front of the finder and replace it with a *reducer lens* to correct the image size.

Without the reducer lens, the full field of the viewfinder approximates 17.5mm.

Parallax adjustment:

To align vertical cross hair:

1. Loosen parallax lock knob (see Sec. 16.11b, Fig. 16-36), which is positioned in the horizontal restricted slot between the focus lock knob and the dovetailed bracket at the top front of the finder. 2. Move rear of finder horizontally until vertical cross hair in finder matches reference point of cross hair in focusing tube. Secure parallax lock knob.

NOTE: A follow-focus unit with parallax-correction cams is also available. (See Sec. 16.11b.)

To align horizontal cross hair (in finder—with horizontal cross hair in focusing tube):

1. Verify that viewfinder dovetail is properly seated in the viewfinder bracket before making *any* adjustments. Sight cross hair on horizontal reference point through focusing tube. Lock the camera down. 2. Loosen lock nut of vertical-adjustment screw (see Sec. 16.11b, Fig. 16-36) which is located on the pivot point near the dovetailed bracket. Turn the hex-head adjustment screw clockwise to move the finder cross hair *up*; counterclockwise to move the finder cross hair *down*. 3. Align the horizontal cross hair in the viewfinder with the horizontal reference point in the focusing tube.

Focus knob (see Sec. 16.11b, Fig. 16-35): The large knurled knob at left side of finder behind the prism box. It causes the prism box to slide in and out on a shaft. The prism box is secured at the desired focus by a lock knob above the shaft.

Pivot point (see Sec. 16.11b, Fig. 16-36): Viewfinder swings vertically for access to camera door. To pivot the finder, loosen the knurled finder tilt lock located in the restricted slot forward of the dovetail lock.

16.7i Sunshade/matte box (not shown)

Bellows-type sunshade/matte box mounts on two rods that fit into a bracket. The bracket is independent of the camera, and has two locating pins and one screw that insert in mating holes in bottom front of the base.

The sunshade/matte box is adjustable up and down; left and right; in and out. Top of the matte box is fitted with an extension-shade screw.

To verify clearance: Sight through the focusing tube, run forefinger around inner edge of matte-box opening—if tip of finger is visible, move entire unit toward lens. Repeat check until matte box is clear of lens.

A standard matte box allows use of the 15mm lens if the bellows is fully collapsed. The Mitchell 16 has *no* wide-angle matte box. The standard matte box must be removed entirely to use a lens wider than 15mm.

The 100mm lens must be removed from the turret in order to slide the matte box far enough toward the camera to clear the other lenses.

16.7j Filters

Gauze holders and matte frames are housed in the matte box. A pola-screen, one 2 × 2 in. glass filter holder, and one 3 × 3 in. glass filter holder are housed in the bellows.

Gelatine: Filter slot for internal filter is located in the aperture plate (*inside* the camera—see Fig. 16-26). The camera door must be opened each time a filter holder is inserted (or removed). When inserting filter holder the bent portion of holder (used as a finger-grip) should be pointed toward the Operator. To check filter after insertion in aperture plate, remove the taking lens to expose the aperture opening in the upright section of the base. Determine visually that gelatine "covers" the aperture.

16.7k Door: Hinged at bottom.

To open: Depress catch in door; pull out and down.

To close: Lift until flush with camera; pull focusing tube to verify door is secure.

16.7l Magazines: 400-ft (shown Fig. 16-27) and 1200-ft.

To mount:

1. Pull a loop from the magazine feed side. 2. Insert the magazine

Fig. 16-26. Mitchell 16 threading. Courtesy of Mitchell Camera Corp.

1. Filter slot
2. Pressure plate
3. Registration-pin throw knob
4. Upper idler roller
5. Middle idler roller
6. Upper sprocket-guide roller
9. Sprocket
10. Lower twin rollers
11. Pulldown claw
12. Register-plate scribe mark
13. Aperture-plate lock

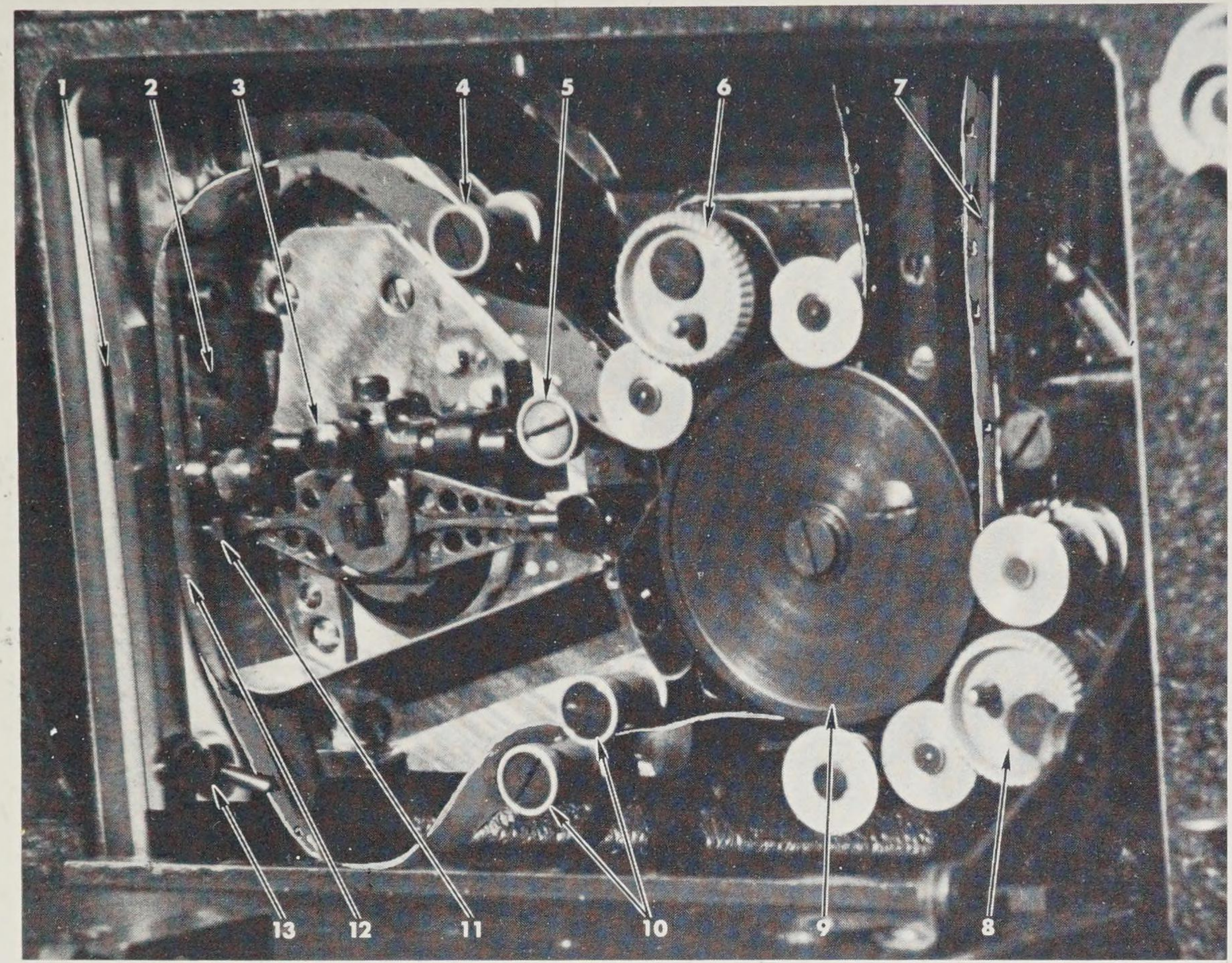
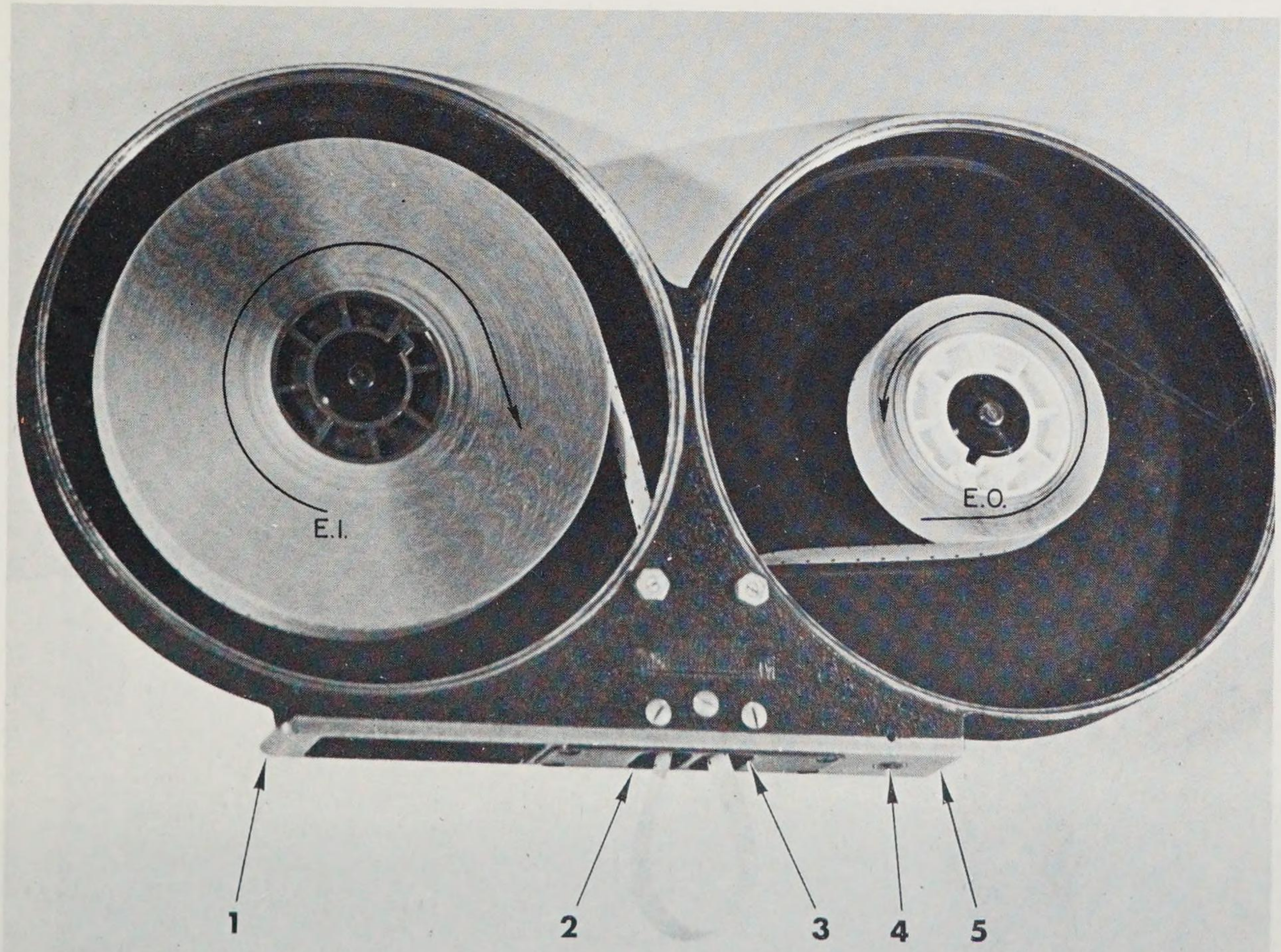


Fig. 16-27. Mitchell 16; R-16 magazine. Courtesy of Mitchell Camera Corp.

1. Magazine toe
2. Feed light trap
3. Take-up light trap
4. Lockdown screw hole
5. Magazine heel



toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 3. Slide magazine forward and down until tapped hole in magazine heel aligns with the magazine lockdown screw. Rotate the magazine lockdown knob clockwise (located at top-left rear of camera) to tighten magazine to camera. Thread camera (see Sec. 16.7m).

To remove: Unthread film and break it. Place two fingers under the belt, pull laterally away from the magazine, rotate the fingers clockwise, and lift the belt from the spindle wheel groove. Disengage the magazine by rotating the lockdown screw counterclockwise and lift the magazine clear of the camera.

16.7m Threading (Fig. 16-26)

1. Press buckle-trip toward rear of camera to avoid accidental starting of camera during threading procedures (see Sec. 16.7n). Rotate upper and lower sprocket-guide rollers counterclockwise away from the sprocket. 2. Rotate manual turning knob on motor (see Fig. 16.25) until pulldown claw aligns with scribe mark on register plate (this indicates claw is retracted from aperture plate). Rotate registration-pin throw-out knob counterclockwise. 3. Raise aperture-plate lock, remove aperture plate by pulling *gently*. If plate does not slide easily, check to see if pulldown claw and/or registration-pins are clear of plate. 4. Clean plate. Make a special check of registration pin and pulldown claw holes for emulsion build-up or film chips. Replace the plate. Depress aperture plate lock to secure. 5. Swing pressure plate spring arm clockwise. Remove pressure plate from register plate; clean. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to lower front corner of camera (a rough guide for amount of film needed for threading). Starting clockwise from the magazine take-up side, insert film: (a) Between lower sprocket-guide rollers and sprocket. (b) Between the lower twin rollers. 7. Starting counterclockwise from the magazine feed side, insert film: (a) Between the upper sprocket-guide rollers and sprocket. (b) Over the middle idler roller. (c) Under the upper idler roller. (d) In groove (the race) between the removable aperture plate and stationary register plate. 8. Place forefinger and little finger above and below the register plate to hold film straight in the race. Align perforation hole in film with index mark inscribed in lower part of register plate. *Gently* rotate registration-pin throw-out knob clockwise to determine if registration pins are entering film perforations. If pins touch film, raise or lower the film in the race while rotating the pins back and forth until they drop into the perforations. 9. (a) Adjust lower loop so that when lower sprocket-guide roller closes, the loop will clear bottom of box by 1/8–1/4 in. at the lowest arc of loop. (b) Adjust upper loop so that when upper sprocket-guide roller closes, the arc of loop aligns with top of movement plate. 10. Rotate the magazine take-up spindle wheel clockwise to take up the film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise

direction, slip belt into wheel groove (this follows the rotation of the take-up wheel and subjects the belt to minimum stretching). 11. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 12. 12. Push buckle-trip reset button at back of camera above counter (see Fig. 16-25); hold pins on upper and lower sprocket-guide rollers with thumb and forefinger.

CAUTION: Keep the knuckles of the hand clear of the movement!

Apply power in short bursts and observe action of film. If satisfactory, stop camera, close door, and reset footage counter.

16.7n Buckle-trip (see Fig. 16-26)

Apron (a vertical metal strip) located behind take-up side of the sprocket. The apron cuts out power automatically if film fails to take up when camera is running. Power should be deliberately cut out prior to threading (by tripping apron toward rear of camera) to prevent accidental starting of camera.

To reset: Push reset button located above footage counter (see Fig. 16-25).

16.7o Footage and frame counters

Located at back of camera above bubble level (see Fig. 16-25).

Footage counter: Additive. Registers each foot of film transported through camera up to 999 ft, then reverts to zero and counts forward again. May be reset to zero each time magazine is changed; reset knob is located at left rear side near camera door.

Frame counter: Additive in increments of 2 frames up to 40 frames, then reverts to zero and counts forward again. Does not reset.

16.7p Tachometer

Located at back of camera (see Fig. 16-25). Registers speeds from 12–36 fps in increments of one frame per second. When speed exceeds 36 fps the camera tachometer is superseded by the tachometer on a "wild" (variable-speed) or high-speed motor.

16.7q Shutter

Variable; Professional: 0–235° (Fig. 16-25). (Cameras previous to serial no. 227, not shown, have a variable shutter of 0–175° only.)

HS (high-speed camera) (not shown): 0–140° only, regardless of the serial number. Calibrations and external control at back of camera.

To change shutter opening:

1. Pull out and turn locking-pin knob in handle to move arm. When desired shutter opening appears at slot in shutter handle, proceed to step 2. 2. Rotate knob until positive locking pin drops into place. Agitate handle to test engagement of pin.

To clear the shutter from the lens: Remove lens from lens mount. Observe shutter through lens port. Rotate manual motor-turning knob (see Fig. 16-25) until shutter clears camera aperture.

16.7r Lubrication (Fig. 16-28)

Manufacturer recommends lubricating the following parts every 1000 ft with one or two drops of oil: Registration-pin pads (oilers); register shaft (both sides of bracket); pulldown-claw cam at upper corners; plunger arm; pressure-plate rollers.

NOTE: After oiling, run camera to eliminate excess oil, and wipe interior.

16.7s Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

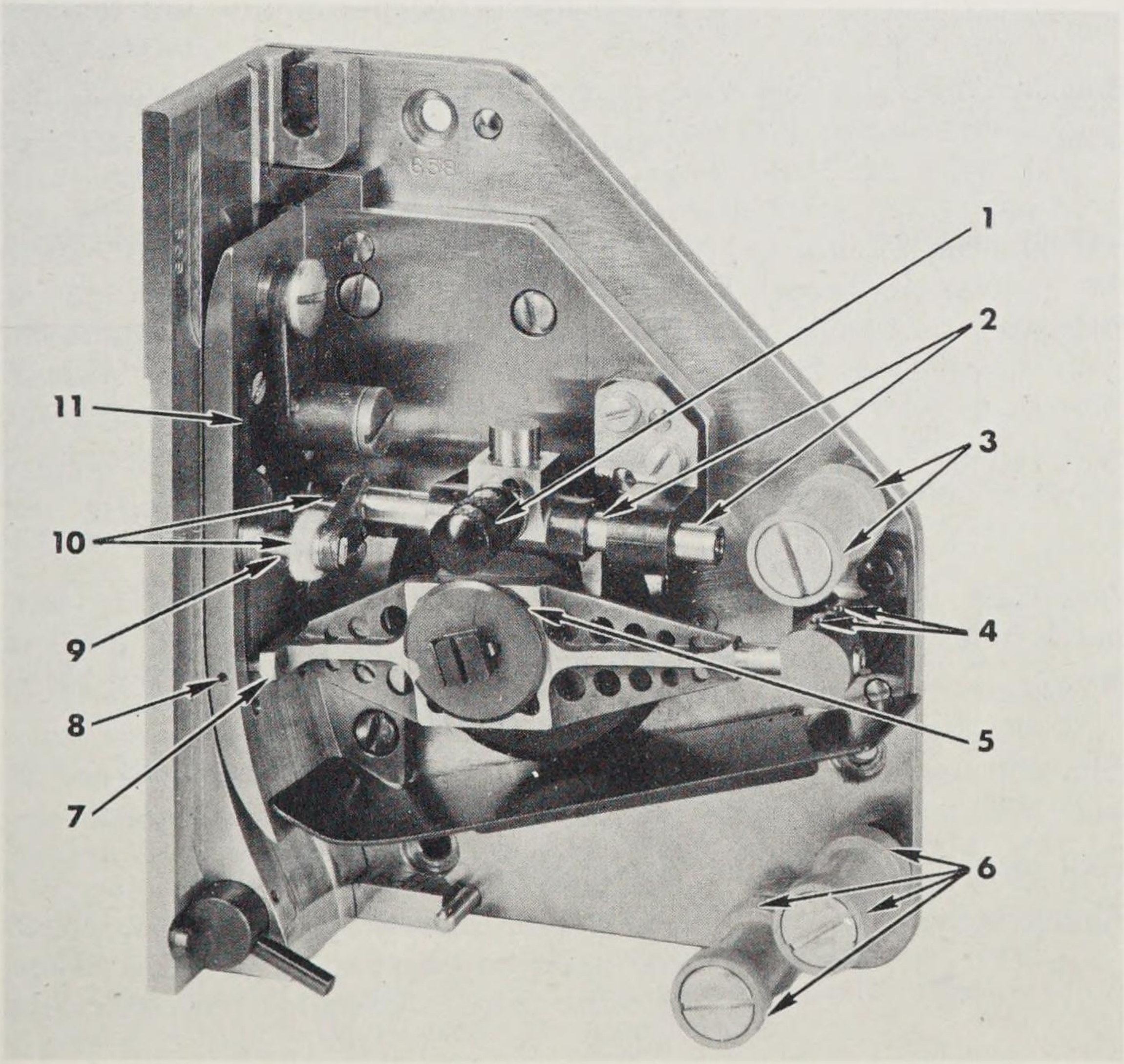


Fig. 16-28. Mitchell 16, lubrication points. Courtesy of Mitchell Camera Corp.

1. Registration-pin throw-out knob
2. Registration shaft
3. Idler rollers
4. Plunger-arm oil holes
5. Pulldown-claw cam
6. Idler rollers
7. Pulldown claw
8. Register plate scribe mark
9. Registration pin (one of two)
10. Oilers
11. Pressure-plate rollers (not visible)

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

16.7t Weight: (with 400-ft load) 42 lb.

16.7u Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; camera racked over; power-line connection faulty; low temperature
Camera door will not close	Sprocket-guide rollers not seated properly; registration-pin throw-out knob not forward; film chip or dirt in door
Camera "hunts"	Camera not warmed up; voltage variation in power line
Film jam	Improper threading; take-up belt not on; magazine cover not relieved on "dished" roll
Lens will not focus	Lens not screwed all the way into mount; mount not seated properly; turret not seated properly; lens damaged
Viewfinder does not match focus tube cross hair	Camera not completely racked over; viewfinder not properly seated in dovetail bracket; viewfinder parallax not set; turret not seated properly
Film will not slide into race	Registration pin or pulldown claw not retracted; emulsion or film chip in race
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up on the following: aperture plate, sprocket-guide rollers, pressure plate, registration pins; magazine rollers
Focusing tube blurred	Magnification knob seated between magnifying position (forward) and normal position (back)
No take-up, or sporadic take-up	Belt slipping, or belt too loose
Cut-in on focusing tube	Internal filter holder not seated in filter slot; turret not seated; matte box extended

16.8 MITCHELL 16 AND R-16 MAGAZINE (Fig. 16-27)

16.8a Type: Double-compartment.

16.8b Capacity: 400-ft (shown) and 1200-ft.

16.8c Lids: Two. Threaded.

To remove: Rotate counterclockwise.

16.8d Feed

Left side. Film (wound emulsion in) pulls off spindle clockwise.

16.8e Take-up

Right side. Film winds on spindle counterclockwise, emulsion always out.

16.8f Loading

1. Unscrew feed lid. 2. In darkness, remove film roll from can and bag. Pull film off roll clockwise. 3. Insert film end between feed idler roller and magazine compartment wall (emulsion faces idler roller). Push film through the feed light-trap rollers. 4. Place roll on the feed spindle. Rotate the feed spindle wheel until the spindle pin engages the core keyway. 5. Replace the feed lid. 6. Unscrew the take-up lid in the light. Insert the film end into the take-up light trap. Push the film between the magazine compartment wall and the take-up idler roller (emulsion faces the roller). 7. Hold core. Rotate take-up spindle wheel until the spindle pin engages the core keyway. 8. Insert film into core slot and wind on the take-up spindle counterclockwise (emulsion side *out*). 9. Replace take-up lid.

NOTE: (a) Relieving a lid one-half turn eliminates "drag" and/or noise of roll which may have "dished" in loading. (b) Mitchell light-trap rollers are velvet covered and require constant checking for lint and dust. While spring tension on the outer rollers helps keep the magazine lighttight, the light trap should be taped or covered with a black bag after loading.

WARNING: (a) When using the 1200-ft Mitchell 16 magazine, a camera-belt change is necessary. (b) When using the 1200-ft DSR magazine, *no* camera-belt change is necessary. The magazine is fitted with an intermediate (double) spindle wheel. The standard 400-ft camera belt attaches to the outside wheel. A "permanent" belt is attached from the inside wheel to the take-up spindle wheel. (c) Mitchell 16 and R-16 magazines are interchangeable.

16.8g Unloading

In darkness, take up all slack; unscrew take-up lid; place middle finger on core and thumb on edge of roll. Turn magazine over, remove film roll, and place exposed roll in black bag and can.

16.8h Footage counter: None.

16.9 MITCHELL 16 BLIMP (Figs. 16-29, 16-30)

NOTE: All directions are from the Operator's point of view.

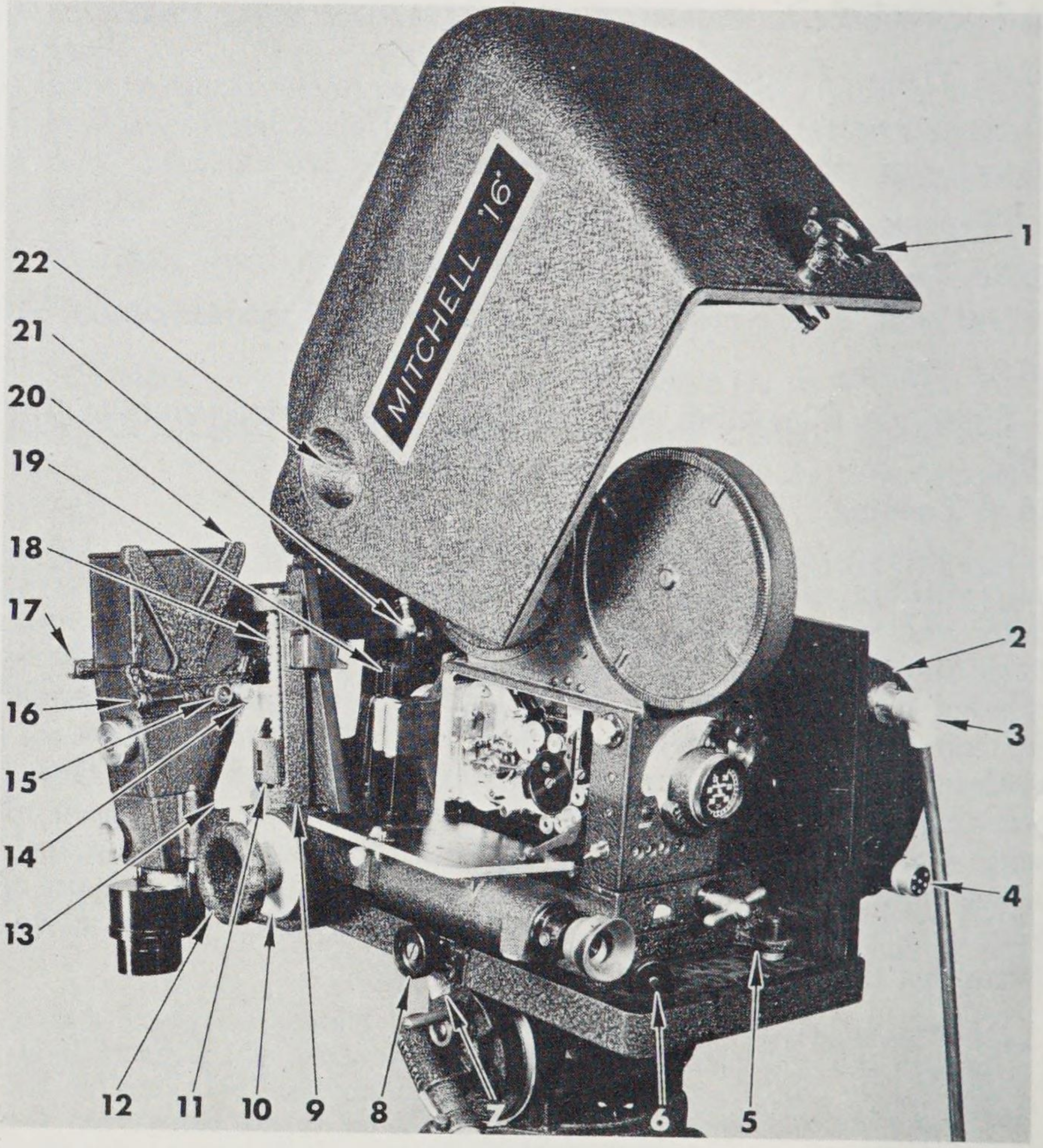


Fig. 16-29. Mitchell 16 blimp (open). Courtesy of Mitchell Camera Corp.

1. Scalloped access knob
2. Camera motor cover
3. External power line
4. Internal motor connection (optional)
5. Camera support plate
6. Offset camera-lockdown knob in plate
7. Vertical bracket height-screw adjustment
8. Follow-focus bracket lockdown knob
9. Follow-focus bracket
10. Marking disc
11. Cam holder
12. Follow-focus knob
13. Cam
14. Cam roller
15. Cam adjusting screw-lock
16. Adjusting screw
17. Upper section viewfinder harness
18. Worm gear
19. Filter holders
20. Lower section viewfinder harness
21. Internal lens light
22. Magnifying window

16.9a Base

Bottom fitted with a ⅜"-16 tapped hole to accommodate tripod lockdown screw.

CAUTION: When blimp is mounted on a Worrall Geared Head, a riser (see Sec. 9.5) is required to clear the blimp front door from the geared head's upper rails.

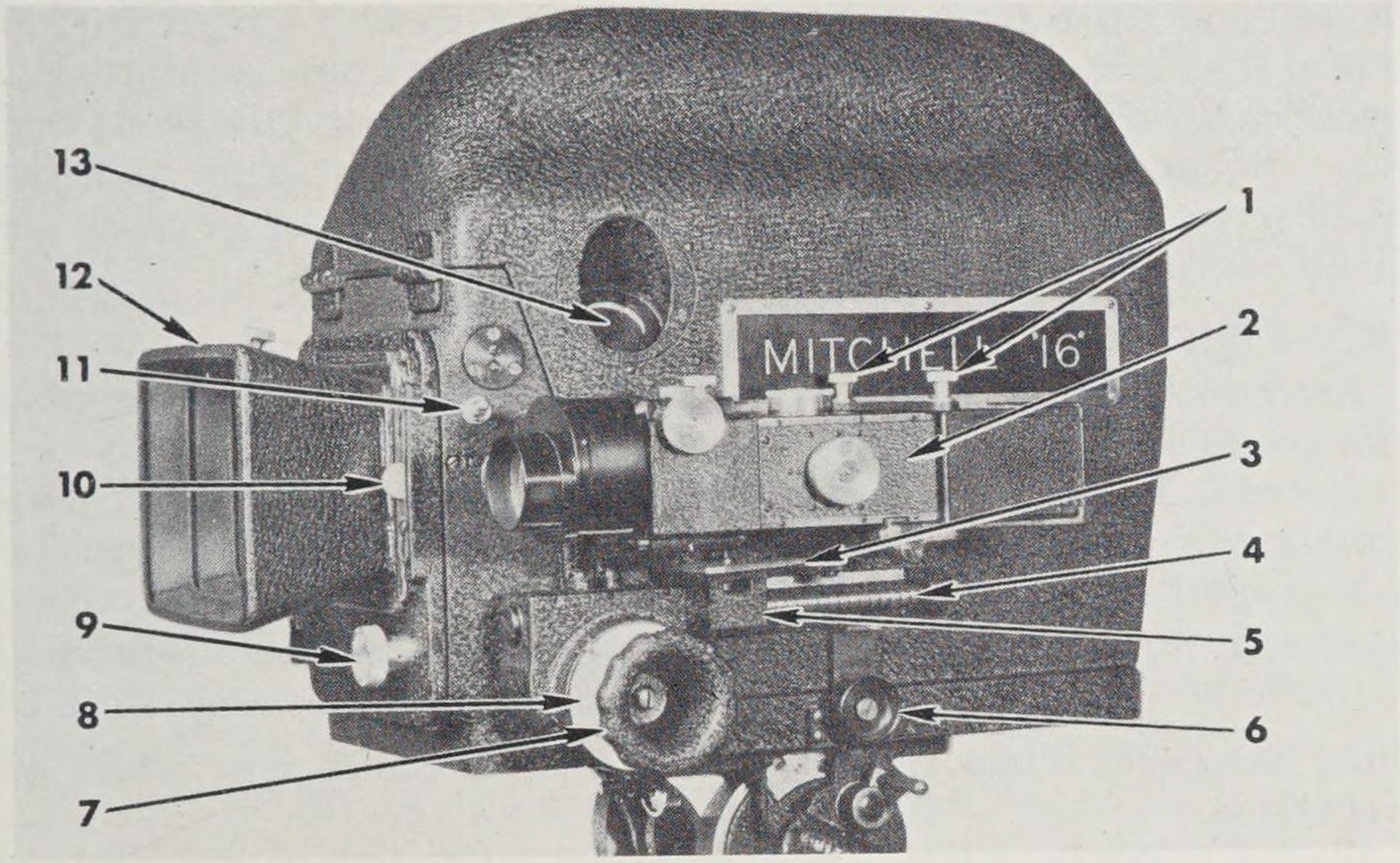


Fig. 16-30. Mitchell 16 blimp (closed). Follow-focus bracket in shooting position. Courtesy of Mitchell Camera Corp.

1. Viewfinder harness screws
2. Offset viewfinder
3. Cam
4. Worm gear
5. Cam holder
6. Follow-focus bracket lockdown knob
7. Follow-focus knob
8. Marking disc
9. Lens access knob
10. Hood latch
11. Internal light toggle switch
12. Sunshade/blimp hood
13. Lens magnifying window

16.9b Camera preparation

Remove offset viewfinder from camera (see Fig. 16-41). Magazine may be on camera and threaded. Remove matte-box bracket and rods from camera.

16.9c Access

To blimp interior: Rotate scalloped access knob (see Fig. 16-29) at back of blimp counterclockwise to open. Top, hinged at front, lifts up and away from Operator. (Some blimps may have a button in the handle that is depressed to open.)

CAUTION: On older blimps, place a small wooden wedge at the hinge to prevent the blimp top from accidentally dropping shut.

To lenses (see Fig. 16-30): Rotate lens access knob on front door counterclockwise; open door and swing it to the right.

To motor: Rotate counterclockwise the two knurled screws on the motor cover (see Fig. 16-29). Lift cover from holding lugs.

16.9d Camera insertion

1. Swing front door open. Loosen lens-coupling–arm lock (not

shown) and move the coupling-arm gear (not shown) toward the left side of the blimp. 2. Raise blimp hood. Slide camera onto internal plate (see Fig. 16-29) until front and right sides of camera base fit against stops. Rotate offset camera-lockdown knob at rear of plate until the ⅜″-16 screw in center locks camera to plate. Camera may be placed in blimp with motor and magazine in place.

16.9e Power line

External (see Fig. 16-29): Uses standard camera line. Cannon plug inserts into fitting on motor cover.

Internal: Extension (in motor cover) fits into camera body. Line must follow contour of cover or it may prevent camera from racking over properly.

NOTE: Motor cover on right side of blimp might be fitted with an ON/OFF switch holder, but this is a luxury, not standard equipment.

16.9f Sunshade/blimp hood (see Fig. 16-30): Slides into recess on front door.

To lock: Slide hood latch (on outside of front door) *down.*

To soundproof: Insert optical flat glass (inside door) into recess. To lock in place, turn small knurled latch (not shown) clockwise.

16.9g Internal light

Toggle switch (see Fig. 16-30): Located at left side of blimp exterior below the lens magnifying window. Light is inside blimp front and illuminates the taking-lens barrel (see Fig. 16-29). The combination of magnifying lens and internal light provides an easy visual check of lens and footage settings. The internal battery-powered bulb in a flexible socket may be moved to various positions around the top of the camera turret.

To change batteries:

1. Open the lens access door. Reach in and unlock internal-spring holder (above lens-access door). 2. Lower the holder, remove cap; insert new batteries, replace holder above lens access door.

CAUTION: Lamp must be turned "OFF" while shooting so that the optical flat in the door will not reflect light into the lens.

16.9h Coupling alignment

Lenses:

1. Rotate lens-access knob (see Fig. 16-30) below matte box and swing front door open. 2. Loosen coupling-arm lock (not shown) and move coupling-arm gear away from taking lens. 3. Rotate follow-focus knob (see Fig. 16-30) counterclockwise until cam holder on worm gear is as far *forward* as it will go. 4. Set lens at infinity, or slightly beyond if teeth will not mesh precisely at infinity. 5. Set coupling-arm gear into teeth of geared ring on lens; tighten coupling-arm lock. 6. Set *f*/stop manually; close front door. 7. Place cam (of the same focal length as taking lens) onto follow-focus cam holder (see Fig. 16-29).

16.9i Filters

Two 2 × 2 in. glass filter holders (on a single bracket arm) (see Fig. 16-29) slide on short rods attached to the plate inside the blimp.

16.9j Viewfinder (see Figs. 16-29, 16-30, 16-41)

Same as the one used on the camera. It slides into the dovetail on the blimp follow-focus bracket (see Fig. 16-29).

To utilize: Install two-piece harness at rear of finder (see Fig. 16-29).

Harness

Upper section (piece no. 1) (see Figs. 16-29, 16-30): Consists of a straight flat bar containing two long knurled screws.

Lower section (piece no. 2) (see Fig. 16-29): Consists of a Y-shaped bracket with heavy base. The base includes: (a) A cam roller (steel bushing that rides against cam). (b) Cam-adjusting screw (to make fine adjustment of *vertical* finder cross hair to match cross hair in focusing tube).

NOTE: To align *horizontal* cross hair, see Sec. 16.9k.

(c) Cam-adjusting–screw lock (frees and secures cam adjusting screw). (d) Two tapped holes (to receive knurled screws from upper section).

The Y-shaped bracket includes (a) 90° raised edges at the end of each arm. (b) A finder-return spring (the hook on the spring attaches to the blimp follow-focus unit, causing the viewfinder to ride on the cam).

To install harness:

1. Hook the 90° raised edges of the Y-shaped bracket to the bottom rear of the finder (see Fig. 16-29). 2. Rest upper flat bar across top of viewfinder and secure screws into tapped holes in lower section. (See Sec. 16.11b, Fig. 16-36.)

CAUTION: Hand-tighten only!

NOTE: Harness for the blimp differs from the harness of a standard follow-focus attachment (see Sec. 16.11b) in that the blimp cam roller is an integral part of the harness, and *cams* ride on the blimp follow-focus worm-gear unit. In a standard follow-focus attachment, the cams fit to the harness and the cam *roller* rides on the worm gear.

16.9k Follow-focus bracket

Left side. Bracket consists of a follow-focus knob attached to a worm gear which moves the cam holder. (See Figs. 16-29, 16-30.)

To clear viewfinder from side of blimp: Loosen follow-focus bracket lockdown knob, swing follow-focus bracket and viewfinder vertically.

NOTE: The follow-focus bracket is held horizontally along the axis of the lens by securing the follow-focus bracket lockdown knob, and is adjustable up and down.

To align horizontal cross hair in viewfinder with cross hair in focusing tube:

1. Loosen lock nut (beneath bracket lockdown knob). 2. Adjust vertical-bracket height screw up or down until horizontal cross hair in

viewfinder matches horizontal cross hair reference point in focusing tube. Tighten lock nut.

NOTE: The 16mm blimp follow-focus bracket differs from the standard follow-focus attachment, which fits directly to the camera. (See Sec. 16.11b.)

16.9l Cams (See Figs. 16-29, 16-30)

Cam holder must be as far forward on the follow-focus bracket as possible prior to mounting a cam on it.

To mount:

1. Loosen cam lockdown screw (not shown) in cam holder and place cam on rear pilot pin (with hypotenuse of cam facing left and rear).
2. Pivot cam forward and slide it under the cam lockdown screw until notches in the cam abut the cam lockdown screw and forward pilot pin. Lock in place.

NOTE: When cams are not slotted remove the cam lockdown screw, place the cam on the pilot pins (not shown) of the cam holder, and replace the cam lockdown screw.

Finder return spring: Must be attached in order for the finder to ride the cam.

Parallax check: Should be made at every change of lens and cam to verify alignment of the viewfinder and focusing-tube cross hairs.

NOTE: Cams fitted to a blimp are placed on the holder differently than cams fitted to a standard follow-focus attachment. (See Sec. 16.11b, Fig. 16-36.)

16.9m Ports

Window at back of blimp permits viewing of tachometer, footage counter, and bubble level. (Some blimps do not have a back window —blimp must be opened to check tachometer, footage counter, etc.) Magnifying window at left front above focusing knob permits viewing of footage and aperture setting on lens.

16.9n Weight: (less camera) 45 lb.

16.10 MITCHELL R16 (SS AND DS) CAMERAS (Figs. 16-31, 16-32)

NOTE: All directions are from the Operator's point of view.

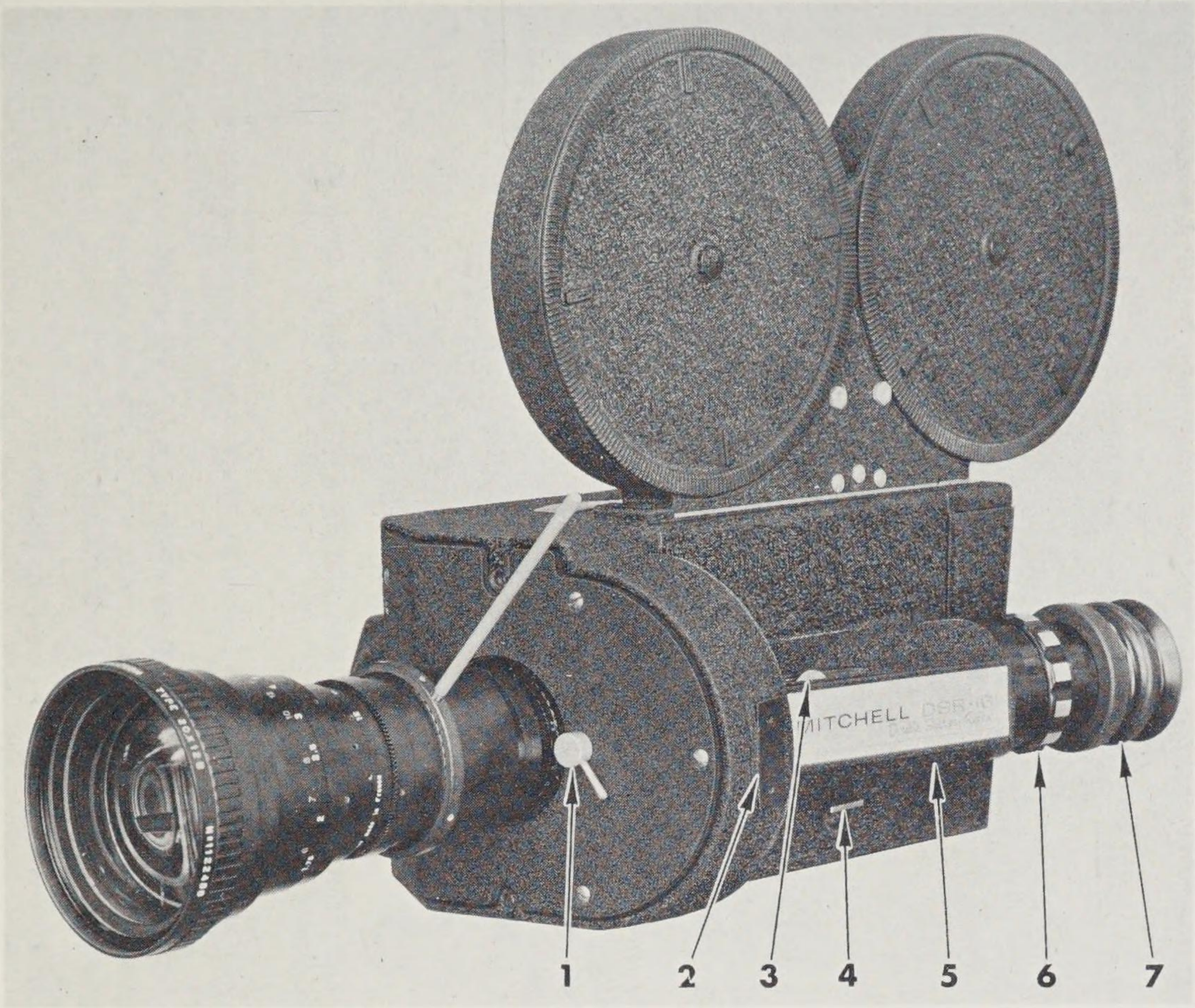
NOTE: The manufacturer states that the model SS-R16 (single system) reflex and the model DS-R16 (double system) reflex cameras are physically and optically the same in all respects, except that the Model DS-R16 is not equipped with an integral sound-recording capability. The DS-R16 film movement is provided with an optional single- or dual-pin registration. Also, the DS-R16 uses only two film drive sprockets instead of three, as found on the SS-R16.

16.10a Base

Bottom is fitted with two ⅜"-16 and one ¼"-20 tapped holes to accommodate tripod locking screw. The Mitchell R16 does *not* have an L-shaped base as do other Mitchell cameras; there are *no* four-way mattes and there is *no* rackover device.

Fig. 16-31. Mitchell SS-R16 and DS-R16 (front view). Courtesy of Mitchell Camera Corp.

1. Lens lock
2. Offset-viewfinder bracket mount
3. Light-trap wheel
4. Door latch
5. Focusing tube
6. Eyepiece locking ring
7. Eyepiece



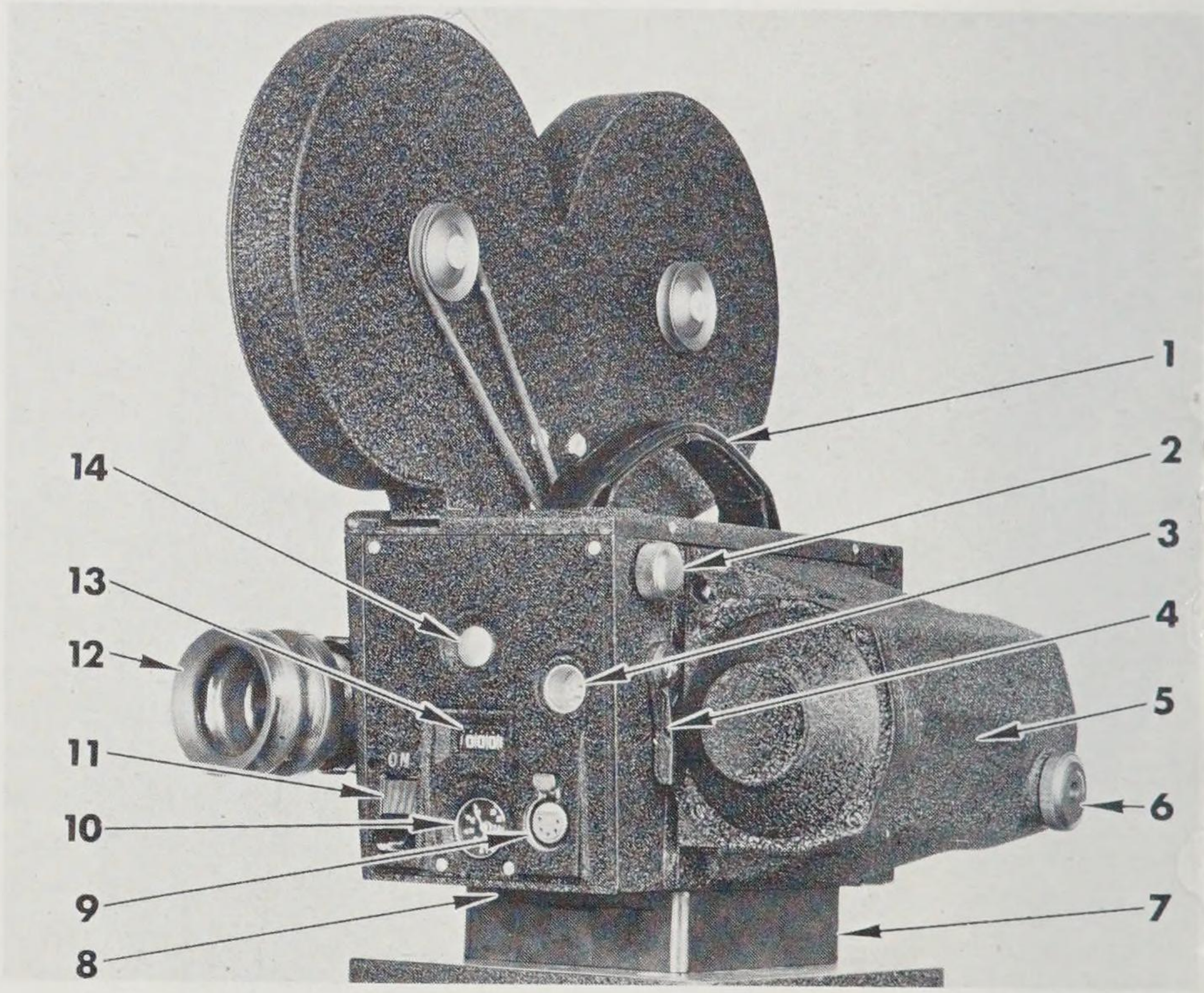


Fig. 16-32. Mitchell SS-R16 and DS-R16 (rear view). Courtesy of Mitchell Camera Corp.

1. Carrying handle
2. Magazine lockdown knob
3. Camera power plug
4. Rear motor latch
5. 12V DC governor-controlled (constant-speed) motor
6. Manual motor-turning knob
7. Adapter plate (base section)
8. Adapter plate (top section)
9. Sound connector plug
10. Tachometer
11. ON/OFF switch
12. Eyepiece
13. Footage counter
14. Buckle-trip reset button

16.10b Adapter plate (see Fig. 16-32)

The unit is optional, thus not used with every camera. It is utilized as a quick disconnect from shoulder-pod to tripod (and vice versa) and is in two sections. Top section of the plate is wedge-shaped and fitted with one ⅜"-16 threaded screw, which attaches it to the bottom of the camera. The wedge inserts into the base of the adapter. Bottom of the adapter base is fitted with one ⅜"-16 tapped hole for placement on a tripod head.

To release wedge: Pull spring-loaded lock pin at left side of base; slide camera back and away.

16.10c Viewfinder/focusing tube (see Fig. 16-31)

Reflex. Magnifies 10×. Views more than full aperture area.

NOTE: An offset viewfinder bracket (not shown) is not standard but might be mounted on the turret housing.

Focusing tube: In camera door as an integral part of the reflex system.

To align reflex mirror for viewing: Rotate manual motor-turning knob at side of motor.

To change or clean groundglass:

1. Remove taking lens. Reach through lens port with fingers, grasp edges of groundglass and pull. 2. Reinsert into camera making certain the chamfered edges are "in" and the V-notch *up*.

NOTE: The Mitchell R16 does *not* have a matte slot, nor does it take an effects matte.

CAUTION: It is extremely important to reach through the lens port and push the groundglass into its stop each time the camera is set up.

Eyepiece (see Figs. 16-31, 16-32): Slides in and out; adjusts to achieve focus on groundglass. Scalloped ring locks eyepiece at desired focus.

Light trap: Rotate knurled light-trap wheel (in forward part of focusing tube) (see Fig. 16-31) forward (counterclockwise) to close viewing system. Light trap should be closed when an offset viewfinder is used instead of the reflex system, so that stray light cannot strike mirror and "kick back" onto film.

16.10d Motors (see Fig. 16-32): Fitted to right side of camera box.

NOTE: *Synchronous motors* (not shown) and governor-controlled (constant-speed, shown) motors have manual motor-turning knob located at side. *Variable-speed motors* (not shown) have manual motor-turning knob at the right side, the speed-control rheostat at the back.

To mount synchronous, governor-controlled (constant-speed), or variable-speed motor:

1. Rotate manual motor-turning knob until drive coupling and five-pin Cannon plug aligns with drive shaft and receptacle in camera. 2. Snug motor against camera. Rotate the motor latches on camera body (forward latch clockwise, rear latch counterclockwise) until they are vertical.

To reverse variable-speed motor:

1. Turn motor switch to "REV." 2. Transfer belt from take-up to feed spindle wheel. Loop the belt into a "figure 8"; this will cause feed to act as "take-up"; adjust motor speed.

CAUTION: Cover lens when running film back to beginning of scene intended for double exposure.

The following motors are available for the Mitchell SS and DS-R16:

Variable-speed motor: 110V AC/DC (60 Hz) (12–36 fps; 24–64 fps); 110V AC/DC (50 Hz) (12–36 fps; 24–64 fps).

Governor-controlled (constant-speed) motor: 12V DC (24 fps); 12V DC (25 fps).

Synchronous motor: 110V AC (60 Hz) (single phase); 110V AC (50 Hz) (single phase).

Animation motor: None.

16.10e Power line

Input to camera: Insert into recessed five-pin male Cannon receptacle at back of camera. Pins read clockwise, starting from keyway: pin no. 1 is ON/OFF switch to camera; pins no. 2 and no. 3 are buckle-trip switch; pin no. 4 is synchronous generator; pin no. 5 is ground for 12V DC.

For 115V AC, pins no. 1 and no. 3 are AC power.

Sound-connector plug: Pins no. 1 and no. 2 are reproduce head; pin no. 3 is shielded ground; pins no. 4 and 5 are record head.

ON/OFF rocker-type *switch* is at back of camera.

16.10f Turret

Newer models (shown): Single-lens turret port accommodates varifocal (zoom) lens. Lens lock lever is in *center* of turret. Turret does *not* rotate.

Older models (not shown): Three position; 20° divergence. Unlike any other Mitchell camera, the position of the taking lens is *above the turret-release lever.*

To rotate three-lens turret: Depress turret-release lever at lower right of turret. Grasp turret grips (there are three) and turn turret to bring desired lens into position. Release turret-release lever to lock turret.

16.10g Lenses

The base of the R16 lens mount is similar in appearance to an Arriflex mount, i.e., it has a lens channel that inserts into a turret port key, and the base has a circular groove which is grasped by blades located within the turret.

To fit lens to turret

Newer models: Align the channel at the rear of the varifocal lens to the guide key (inside port). Rotate clockwise the lens lock lever at center of turret to clear blades in port. Insert the lens. Rotate lens lock counterclockwise to engage blades in lens groove. Give snug fit to lens lock—do not tighten!

Older models: Grasp lens by knurled footage ring. Align channel (at rear of mount) with the guide key (inside port). Squeeze locking levers at each side of lens port on turret and insert lens into port. Release locking levers. Pull lens gently to ascertain mount is locked in port.

To remove lens

Newer models: Rotate center lens lock lever clockwise: grasp lens and pull gently out of port.

Older models: Grasp knurled footage ring. Squeeze locking levers at each side of the lens port and pull lens away.

CAUTION: On a three-lens turret, always plug an empty port(s) when using less than three lenses, so as to prevent a light leak.

16.10h Sunshade/matte box: None.

16.10i Filters

Each lens accommodates a circular glass filter in retaining ring.

Gelatine: Filter slot for internal filter is located in the aperture plate (*inside* the camera—see Figs. 16-33, 16-34). The camera door must be opened each time a filter holder is inserted (or removed). When inserting filter holder the bent portion of holder (used as a finger grip) should be pointed toward the Operator. To check filter after insertion in aperture plate, remove the taking lens to expose the aperture opening. Determine visually that gelatine "covers" the aperture.

> CAUTION: Manufacturer emphasizes frequent inspection of the filter. Dirt or lint on the gelatine may register on the film when the lens is stopped down. Manufacturer recommends that gelatine filter be removed after each take and inspected. Many Cameramen refuse to use the internal filter.

16.10j Door: Hinged at top.

To open: Lift latch below viewfinder, pull out and up.

To close: Lift door to relieve hinge catch. Lower the door so that it is flush with camera; pull focusing tube to verify that door is secure.

16.10k Magazines: 400-ft (shown), 1200-ft.

To mount:

1. Pull a loop from the magazine feed side. 2. Insert the magazine toe into the magazine guide groove (at top of camera). Draw film loop into camera body. 3. Slide magazine forward and down until tapped hole in magazine heel aligns with the magazine lockdown screw. Rotate the magazine lockdown knob (at top right, rear of motor mount) clockwise to tighten magazine to camera. Thread camera (see Sec. 16.10l).

To remove: Unthread film and break it. Place two fingers under the belt, pull laterally away from the magazine, rotate the fingers clockwise, and lift the belt from the spindle wheel groove. Disengage the magazine by rotating the lockdown knob counterclockwise; lift the magazine clear of the camera.

16.10l Threading

Model SS-R16 (Single-System)—(Figs. 16-33 and 16-34)

1. Press buckle-trip toward rear of camera to avoid accidental starting of camera during threading procedure. Then: (a) Pull pin and move the no. 1 sprocket guide (located at upper-left front) *down.* (b) Pull pin and move the no. 2 sprocket guide (center bottom) toward back of camera. (c) Pull pin and move the no. 3 sprocket-guide roller (at the upper-right rear) toward back of camera. 2. Rotate manual motor-turning knob (see Fig. 16-32) until single pulldown claw (at the bottom of its stroke) retracts from the aperture plate. Rotate registration-pin throw-out knob counterclockwise. 3. Raise aperture-plate lock, remove aperture plate by pulling *gently.* If plate does not slide easily, check to see if pulldown claw and/or registration pin is clear of plate.

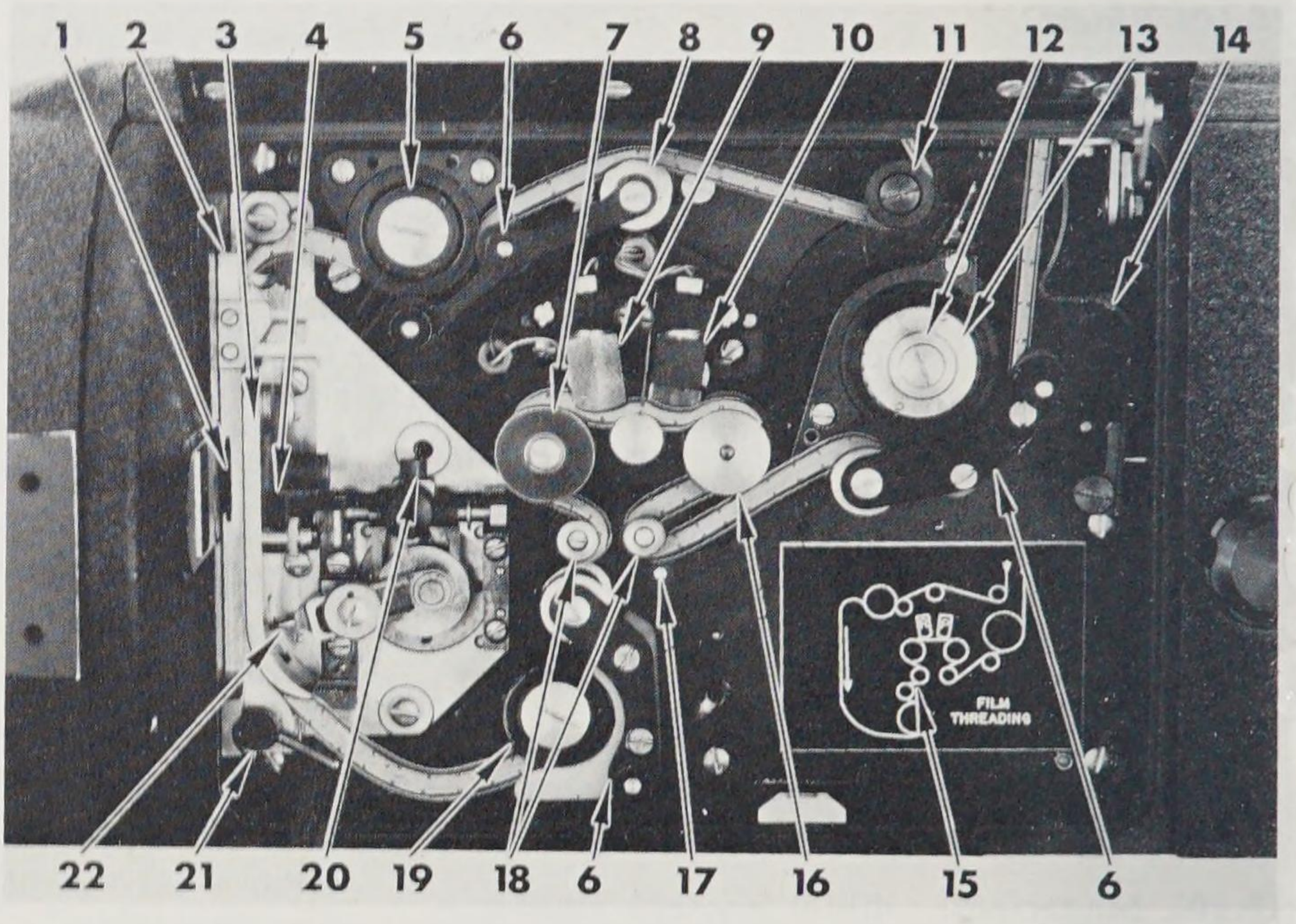


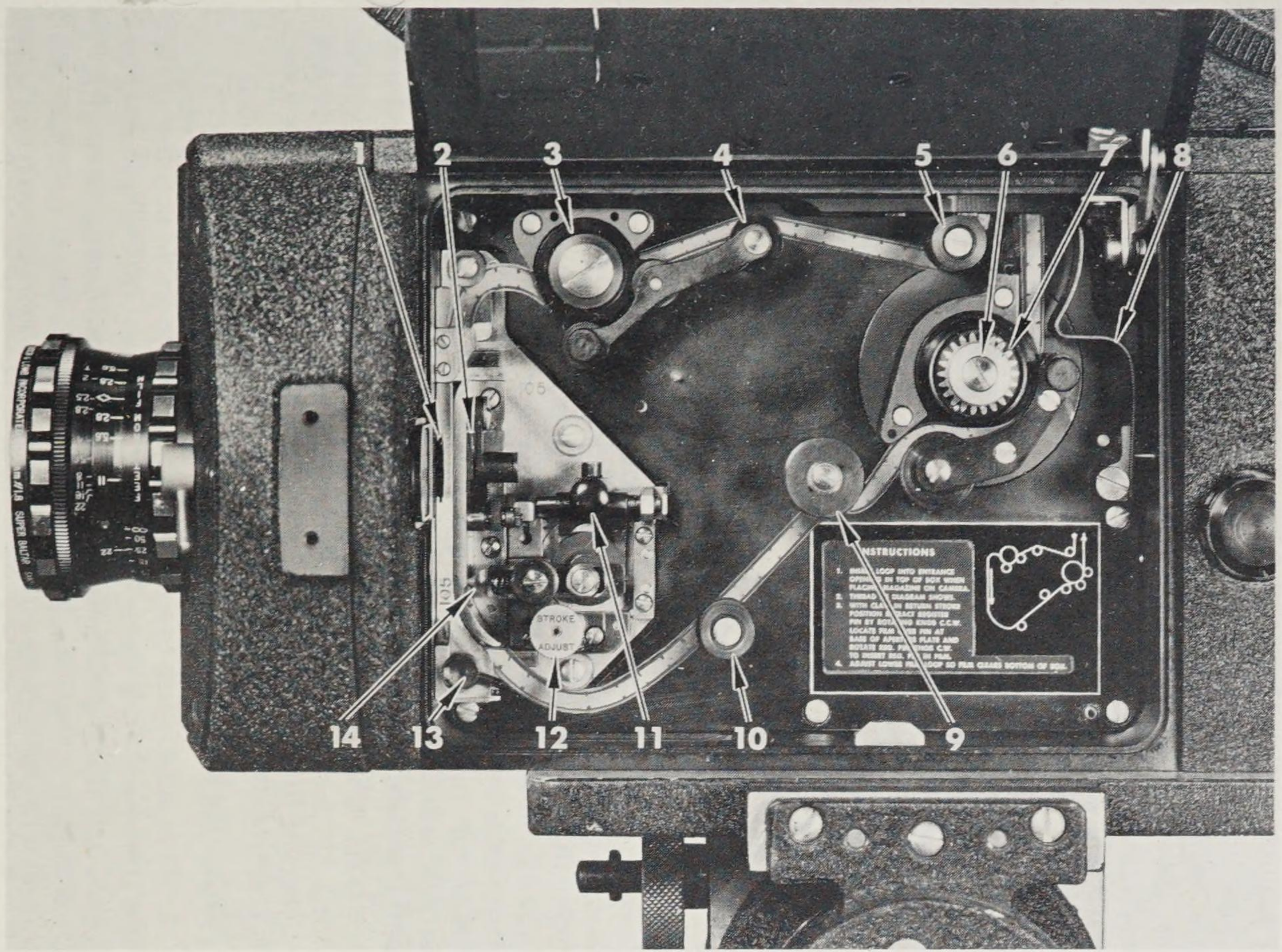
Fig. 16-33. Mitchell SS-R16 threading. Courtesy of Mitchell Camera Corp.

1. Filter slot
2. Aperture plate
3. Register plate
4. Pressure plate
5. No. 1 sprocket
6. Sprocket guides
7. Sound roller
8. Upper film-guide roller
9. Record head
10. Reproduce head
11. Throat roller
12. Sprocket-adjusting knob
13. No. 3 sprocket
14. Buckle-trip apron
15. Threading diagram
16. Sound drum
17. Tension-roller alignment dot
18. Adjustable tension rollers
19. No. 2 sprocket
20. Registration-pin throw-out knob
21. Aperture plate lock
22. Pulldown claw

4. Clean plate. Make a special check of registration-pin and pulldown-claw holes for emulsion build-up or film chips. Replace the plate. Depress aperture-plate lock to secure. 5. Rotate pressure-plate spring arm clockwise. Remove pressure plate from register plate. Clean. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to front corner of camera (a rough guide for amount of film needed for threading). Starting from magazine feed side, insert film: (a) In groove (the race) between the removable aperture plate and stationary register plate. (b) To right of feed-side throat roller. (c) Over upper film-guide roller and between sprocket guide and no. 1 (upper-left) sprocket. (d) Between no. 2 (center-bottom) sprocket and sprocket guide. (e) To right of the left tension roller. (f) To left of the sound roller. (g) Below record and reproduce heads. (h) To right

Fig. 16-34. Mitchell DS-R16 threading. Courtesy of Mitchell Camera Corp.

1. Filter slot
2. Pressure plate
3. No. 1 sprocket
4. Upper film-guide roller
5. Throat roller
6. Sprocket adjusting knob
7. No. 2 sprocket
8. Buckle-trip apron
9. Upper idler roller
10. Lower idler roller
11. Registration-pin throw-out knob
12. Vari-Stroke adjustment
13. Aperture-plate lock
14. Pulldown claw



of sound drum. (i) To left of the right tension roller. (j) Between no. 3 (upper rear) sprocket and sprocket guide. 7. Align one film perforation hole to film-positioning pin at base of aperture plate and press film onto pin. Use forefinger and little finger to hold film above and below the register plate. Rotate the manual motor-turning knob counterclockwise until pulldown claw engages film perforation. Registration pin will drop in automatically with one full rotation of the manual motor-turning knob. 8. Set pulldown claw at bottom of its stroke: (a) Adjust upper loop so that when no. 1 sprocket guide closes the arc of the loop aligns with top of the aperture plate. (b) Adjust lower loop so that when no. 2 sprocket guide closes the arc of the loop clears bottom of the camera by 1/8–1/4 in. 9. Close no. 3 sprocket guide. Pull out geared knob on no. 3 sprocket to disengage camera drive. Rotate knob until tension on film threaded through camera aligns the center of the left-hand tension roller with the red dot on the mechanism plate and aligns the center of the right-hand tension roller with the white dot on the mechanism plate. Depress the geared knob on no. 3 sprocket to engage camera drive. 10. Rotate magazine take-up spindle wheel clockwise to eliminate film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel and subjects belt to a minimum of stretching). 11. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 12. 12. Press buckle-trip reset button (at back of camera above footage counter—see Fig. 16-32). Apply power in short bursts and observe action of film. If satisfactory, stop camera and close door. Reset footage counter.

NOTE: *When using silent film in single-system camera:* After threading no. 2 sprocket, bypass the sound heads and tension rollers by inserting the film below the right tension roller and into no. 3 sprocket (follow dotted line in diagram).

Model DS-R16 (Double-System)—(Fig. 16-34)

1. Move buckle-trip toward rear of camera to avoid accidental starting of camera during threading procedure. Then: (a) Pull pin and move the no. 1 sprocket guide (located at upper-left front) *down*. (b) Pull pin and move the No. 2 sprocket guide (at the upper-right rear) toward back of camera. 2. Rotate manual motor-turning knob (see Fig. 16-32) until pulldown claw (at the bottom of its stroke) retracts from the aperture plate. Rotate registration-pin throw-out knob counterclockwise. 3. Raise aperture-plate lock, remove aperture plate by pulling *gently*. If plate does not slide easily, check to see if pulldown claw and/or registration pin is clear of plate. 4. Clean plate. Make a special check of registration-pin and pulldown-claw holes for emulsion build-up or film chips. Replace the plate. Depress aperture-plate lock to secure. 5. Rotate pressure-plate spring arm clockwise. Remove pressure plate from register plate; clean. Replace pressure plate and spring arm. 6. Pull film from magazine feed side. Extend loop to front corner of

camera (a rough guide for amount of film needed for threading). Starting from the magazine feed side, insert film: (a) In groove (the race) between the removable aperture plate and the stationary register plate. (b) To right of feed-side throat roller. (c) Over upper film-guide roller and between sprocket guide and no. 1 (upper-left) sprocket. (d) Over lower (small) idler roller. (e) Under upper (large) idler roller. (f) Between no. 2 (upper-rear) sprocket and sprocket guide. 7. Align one film perforation hole with film positioning pin at base of aperture plate and press film onto pin. Use forefinger and little finger to hold film above and below the register plate. Rotate the manual motor-turning knob (see Fig. 16-32) counterclockwise until pulldown claw engages film perforation. Registration pin will drop in automatically with one full rotation of the manual motor-turning knob. 8. Set pulldown claw at bottom of its stroke and adjust upper loop so that when no. 1 sprocket guide closes, the arc of the loop aligns with top of the aperture plate. 9. Close no. 2 sprocket guide. Pull out geared knob on no. 2 sprocket to disengage camera drive. Rotate knob until lower loop clears bottom of camera by 1/8–1/4 in. at lowest arc of loop. Depress geared knob on no. 2 sprocket to engage camera drive. 10. Rotate magazine take-up spindle wheel clockwise to eliminate film slack. Place uncrossed belt at bottom of take-up spindle wheel and, in a clockwise direction, slip belt into wheel groove (this follows the rotation of the take-up wheel and subjects belt to a minimum of stretching). 11. Rotate manual motor-turning knob and observe film being transported in camera. If satisfactory, proceed to step 12. 12. Press buckle-trip reset button (at back of camera above footage counter—see Fig. 16-32). Apply power in short bursts and observe action of film. If satisfactory, stop camera and close door. Reset footage counter.

NOTE: Because the Model DS-R16 movement is provided with optional single- or dual-pin registration, it is important to verify the type of movement in the camera before ordering film stock. When in doubt, order double-perforated film for the DS-R16.

16.10m Buckle-trip

Apron (a curved metal plate) located behind geared sprocket (no. 3 sprocket on the Model SS-R16); no. 2 sprocket on the Model DS-R16 cuts out power automatically if film fails to take up. Power should be cut out prior to threading by tripping the apron, to avoid accidental starting of the camera.

To reset: Push button located above the footage counter at the back of the camera.

16.10n Footage counter (Fig. 16-32)

Located at back of camera above tachometer. Additive. Registers each foot of film transported through camera up to 9999 ft, then reverts to zero and counts forward again. May be reset to zero each time magazine is changed.

Reset knob: Located at left rear near door.
No frame counter.

16.10o Tachometer (Fig. 16-32)

Located at back of camera. Registers speed from 8 to 28 fps in increments of 2 frames per second. When speed exceeds 28 fps the camera tachometer is superseded by the tachometer on a wild (variable-speed) or high-speed motor.

16.10p Shutter: Nonadjustable; 175°.

16.10q Lubrication (Fig. 16-35)

Manufacturer recommends lubricating the following parts every 1000 ft with one or two drops of camera oil: Registration-pin pads ("oilers"); eccentric shaft and register-pin shaft surfaces; pulldown-claw cam-plunger arm; eccentric (through lube holes).

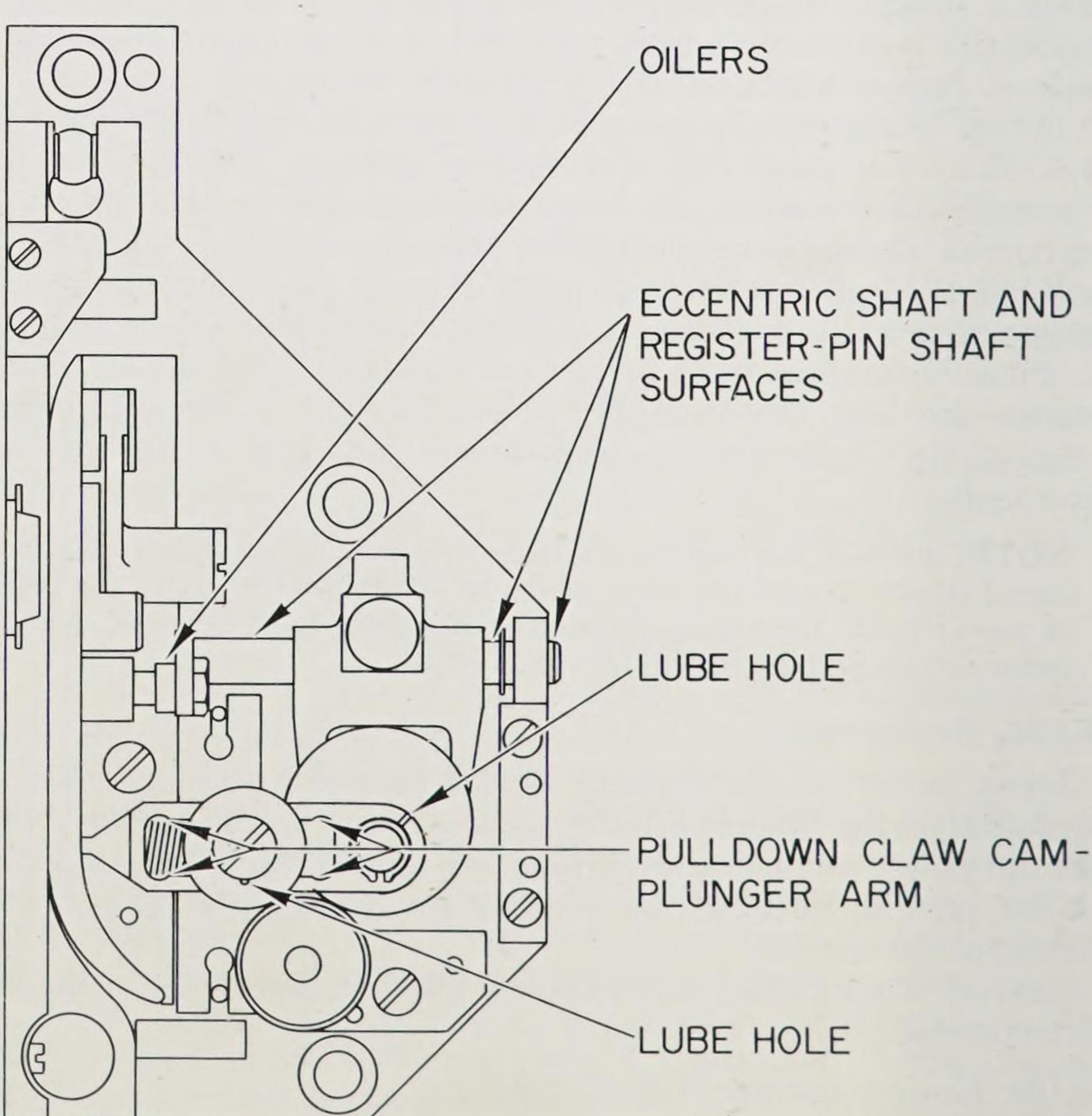


Fig. 16-35. Mitchell SS-R16 and DS-R16 lubrication. Courtesy of Mitchell Camera Corp.

NOTE: After oiling, run camera to eliminate excess oil, and wipe interior.

16.10r Cleaning

Optics: Clean with bulb syringe or soft camel's-hair brush.

Manufacturer recommends the following maintenance *each time film is changed:*

1. Remove aperture and pressure plates. 2. Remove emulsion build-up with orangewood stick. 3. Wipe plates with soft cotton handkerchief (not linen). 4. Use bulb syringe on camera interior to remove dust, dirt, etc.

16.10s Weight

(With 400-ft load): Model SS-R16, 24-1/2 lb; Model DS-R16, 23 lb; (with 1200-ft load): Model SS-R16, 35 lb; Model DS-R16, 33-1/2 lb.

16.10t Troubleshooting

Trouble	*Probable Cause*
Camera will not start	Buckle-trip not reset; power-line connection faulty; low temperature
Camera door will not close	Sprocket-guide rollers not seated; registration-pin throw-out knob not forward; film chip or dirt in door
Camera "hunts"	Camera not warmed up; voltage variation in line
Film jam	Improper threading; take-up belt not on; camera drive not engaged on sprocket no. 2 on DS, sprocket no. 3 on SS; magazine cover not relieved on "dished" roll
Lens will not focus	Lens not seated in turret; turret not seated properly; lens damaged
Film will not slide into race	Registration-pin or pulldown claw not retracted; emulsion or film chip in race
Torn or punctured film	Improper threading
Film scratches	Dirt or emulsion build-up in the following: aperture plate, sprocket-guide rollers, pressure plate, registration-pin; magazine rollers
Cut-in on viewing tube	Shutter not clear of reflex mirror; turret not seated properly
"Wow" or "flutter" on sound phones	Tension rollers not aligned to red and white marks on camera mechanism

Trouble	*Probable Cause*
No take-up or sporadic take-up	Belt slipping, or belt too loose; film off take-up core; loose power connection; take-up clutch too loose or too tight.*

16.10u R16 magazine-loading instructions: see Sec. 16.8.

16.11 MITCHELL ACCESSORIES

16.11a Mitchell Camera Belt

All model belts (except S35R)

To replace old belt:

1. Detach *one* end of old belt from hook and attach one end of *new* belt to that hook (so that it appears to be a continuation of the old belt.) 2. Pull old belt out of camera, automatically bringing new belt into place in camera. 3. When new belt is in place, detach old belt; insert hook through end of new belt, squeezing the hook into belt with pliers.

NOTE: New belt lengths may not have an eyelet for the hook; a jeweler's punch is ideal for punching a new eyelet. Care should be taken to place eyelet properly, leaving no space between belt ends since this would place unnecessary strain on both hook and ends.

To clean: Soak stretched or greasy belts in a capped jar of carbon tetrachloride for a few days.

WARNING: Carbon tetrachloride inhalation is harmful: use in a well-ventilated room.

Treat cleaned belts by pulling belt through cotton dipped in neat's-foot oil.

S35R Belt

To change top-load–type: Pull belt retainer slide *up* (located at point where belt enters camera body); remove belt from grooved drive wheel by pushing belt down and away from wheel. Loop new belt and insert in slot under drive wheel. Replace belt retainer slide.

To change slant-load-adapter–type: Remove knurled screw at right of adapter; unhook belt; attach new belt and pull through.

**To adjust take-up clutch:* 1. Before making *any* adjustment, ascertain that belt is not greasy or has not stretched. 2. Remove motor. 3. Locate the clutch-adjustment screw (at upper left between the flywheel and the female five-pin motor receptacle). 4. Insert screwdriver into clutch adjustment screw (on the Model SS it is in the center of the motor side of the no. 3 sprocket-gear shaft; on the Model DS it is in the center of the motor side of the no. 2 sprocket-gear shaft. 5. Rotate screw in or out so that film magazine takes up immediately upon starting of camera. 6. Replace motor.

CAUTION: Adjust carefully in quarter-turns of the screw. Too tight an adjustment will render the clutch inoperative. Too loose an adjustment will cause the film to buckle or take up loosely on the core.

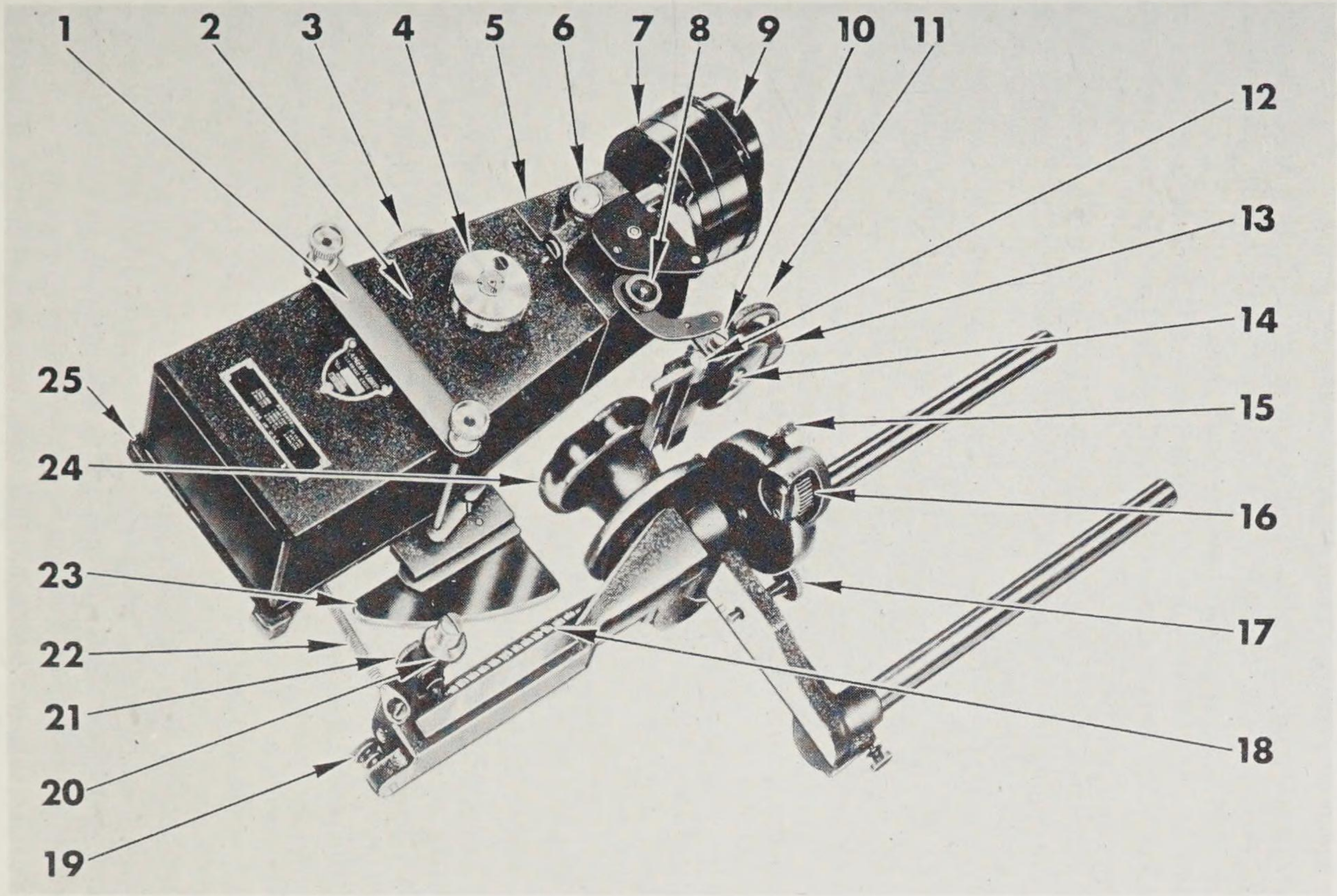


Fig. 16-36. 16mm Mitchell follow-focus attachment. Compare 16mm offset viewfinder with Fig. 16-41. NOTE: focus knob is often factory removed when finder is used on follow-focus attachment. Courtesy of Mitchell Camera Corp.

1. Finder harness: upper section
2. 16mm offset viewfinder
3. Vertical matte-adjusting knob (partially obscured)
4. Horizontal matte-adjusting knob
5. Focus knob
6. Focus lock knob
7. Prison box
8. Parallax lock knob
9. Circular sunshade
10. Vertical adjustment screw
11. Finder tilt lock (not visible)
12. Dovetail lock
13. Dovetail pivot bracket
14. Pivot point
15. Focus-gear engaging lever
16. Lens-focus gear
17. Front-attaching thumbscrew
18. Worm gear
19. Side-attaching thumbscrew
20. Cam roller
21. Cam roller release knob
22. Finder-return spring
23. Cam
24. Focus knob
25. Finder harness: lower section

16.11b Mitchell Follow-Focus Attachment (Fig. 16-36)

The Mitchell Follow-Focus attachment is an L-shaped unit consisting of matte-box rods; lens-focusing gear; worm gear with cam roller; dovetail pivot bracket; finder harness; and cams.

Matte-box rods: The short rod inserts into the left hole at front of the bracket. The long rod inserts into the right hole. Secure both with extension-tube retaining screws.

Focusing knob: A scalloped knob attached to a worm gear which moves the cam roller. The circular plastic marking plate behind it is used to scribe focus changes.

Lens-focusing gear: Meshes with a geared ring on the lens.

NOTE: The lens-focusing gear on the 35mm follow-focus attachment (not shown) is in *two sections*: the front section may be pulled away from the rear section to permit pressing the matte box closer to a wide-angle lens. (Pull pin at front of gear to separate sections.)

One tooth of both sections is painted white with a "witness mark" which is aligned with one tooth of the gear ring on the lens similarly marked.

When both sections are locked together, the witness mark on the front focusing gear must be aligned to the witness mark on the back focusing gear (rotate front section until front gear pin "locks in" into rear gear).

The 16mm follow-focus attachment (shown) has only *one* lens-focusing gear with witness mark, and does not separate.

Cam roller: Rides on the worm gear. The roller must be as far to the rear (infinity) as possible before meshing the lens focus gear to geared ring of a lens set at infinity. The spring-loaded lock nut below the roller pulls out, cam roller drops forward in a restricted slot so that camera door may open all the way.

Dovetail pivot bracket: Inserts into camera dovetail so that viewfinder may be tilted up and forward to gain access to camera interior.

Finder harness: Two-piece.

Upper section: Consists of a straight flat bar containing two long knurled screws.

Lower section: Consists of Y-shaped bracket with heavy base.

Base consists of: (a) cam holder (two pins and lockdown screw); (b) cam-adjusting screw (to make fine adjustments of *vertical* finder cross hair in focusing tube).

NOTE: To adjust *horizontal* cross hair, turn hex screw in dovetail pivot bracket.

(c) Two tapped holes (to receive knurled screws from upper section). Y-shaped bracket consists of: (a) 90° raised bracket at end of each arm; (b) a finder-return spring (hook on spring attaches to screw at rear of cam roller, causing cam to ride on roller).

To install finder harness:

1. Hook 90° brackets of Y to bottom rear of finder; 2. Rest upper flat bar across top of finder and secure screws into tapped holes in lower section.

CAUTION: Hand-tighten only.

NOTE: Harness for viewfinder differs from harness on Mitchell 16 Blimp (see Sec. 16.9j) in that the *cams* fit to the harness and cam *roller* rides on the worm gear. On the 16mm blimp, cams fit to the worm gear and roller is an integral part of the harness.

To mount Follow-Focus Attachment on camera

1. Loosen lens-focusing–gear engaging lever; move lens-focusing gear toward follow-focus knob; lock. 2. Rotate follow-focus knob until cam roller is at extreme rear of bracket (infinity). 3. Insert the two bracket-locating pins (one at each side of front attaching thumbscrew) into mating tapped hole and register holes at front base of camera; tighten thumbscrew. Secure side-attaching thumbscrew (rear of cam roller) into camera. 4. Set lens to infinity; make certain cam roller is in upright position; loosen focusing-gear engaging lever; engage lens-focusing gear and geared ring on lens; lock focusing-gear engaging lever. 5. Place dovetail pivot bracket into camera dovetail; secure. 6. Place harness on finder (Sec. 16.12b); slide finder into dovetail pivot bracket. 7. Place cam that corresponds to lens in taking position on finder-cam bracket (hypotenuse of cam faces right and toward the rear); engage finder-return spring.

16.11c Mitchell Variable-Diffusion Assembly (Fig. 16-37)

Used for special diffusion effects. Two glass graduated diffusers in holders are on rack-and-pinion gears. The optically flat glass of the forward diffuser overlays the optically flat glass of the rear diffuser. When the operating knob is rotated to change the scale from no. 1 to no. 12, the holders simultaneously traverse the camera lens in opposite directions, gradually increasing the diffusion to the capacity of the two diffusers. The shoulder of the numbered scale limits the lateral movement of the holders. The scale scribed 1–12 is for reference only as to the amount of diffusion desired.

When a scene calls for a movement from a long shot to a close-up and requires diffusion on the close-up only, the amount of diffusion used on the close subject is determined visually by the First Cameraman. The reference number on the scale is noted and marked by the Assistant. As the movement is made, the operating knob is rotated from no. 1 (clear) to the reference number for the desired amount of diffusion.

A 3-1/2 × 4 in. filter may be mounted in a holder forward of the diffuser holders.

To mount: Slide wide-angle matte box forward on rods. Lift matte-box filter-holder assembly at rear of matte box *up* and remove. With operating knob at Camera Operator's left, insert variable-diffusion assembly on filter-holder assembly grooves; push down to its limit.

NOTE: (a) The variable diffusion assembly is manufactured for 16mm or 35mm cameras, and the camera size and desired diffusers should be noted when including the assembly as an accessory. (b)

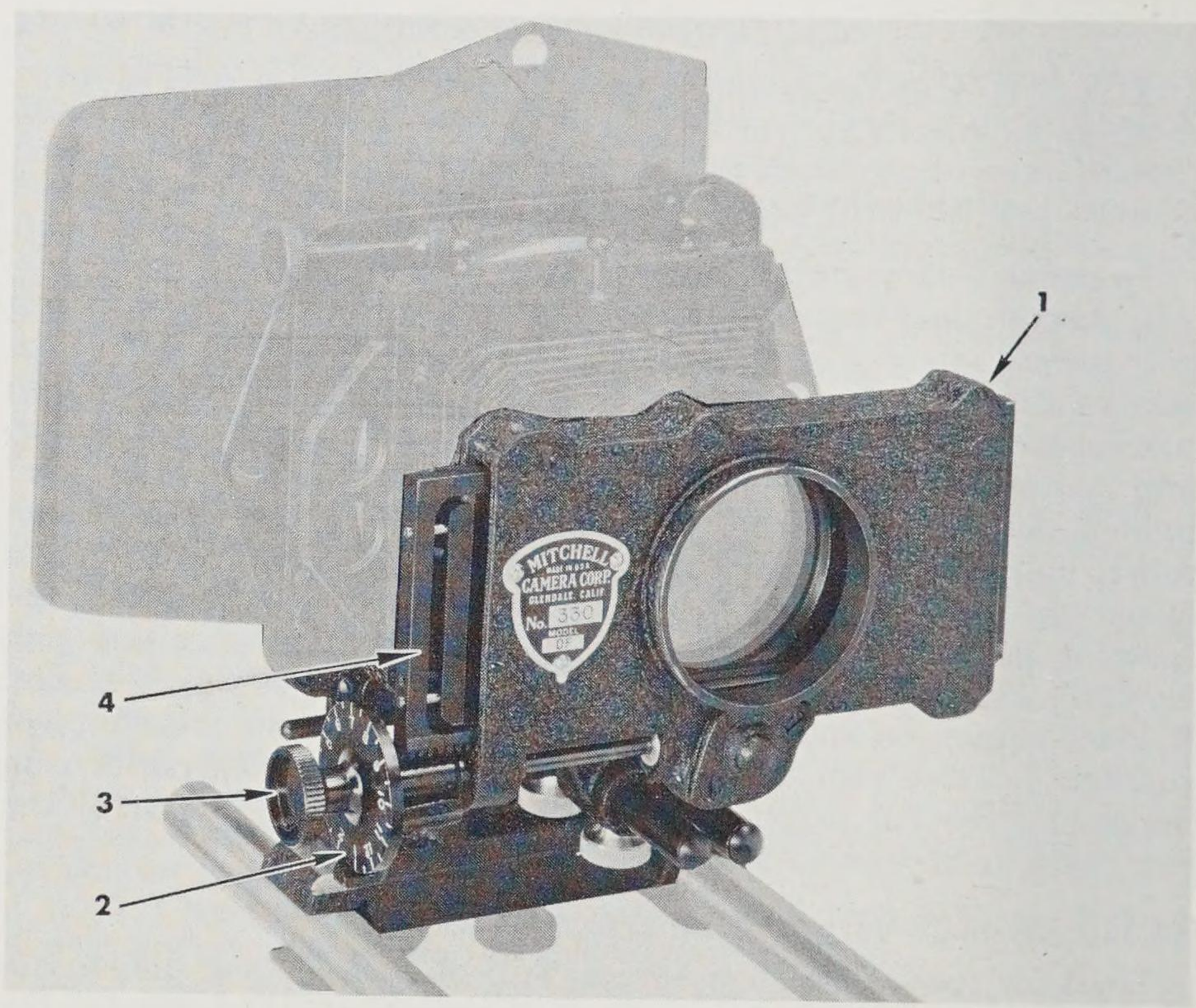


Fig. 16-37. Mitchell diffusion holder. Courtesy of Mitchell Camera Corp.

1. Forward diffusion holder (not visible)
2. Reference scale
3. Operating knob
4. Rear diffusion holder

Diffusion glass is rated alphabetically: A = slight, B = moderate, C = heavy, and D = very heavy.

16.11d Mitchell Matte Cutters

Used when a film-frame effects matte is desired. The frame is cut and inserted into the focusing tube to align an object in a previously filmed scene with an object to be photographed; to create as perfect a match dissolve as possible (e.g., art work to live action, etc.).

There are two types of matte cutters: the block-type and the book-type.

NC, BNC, Standard/High-Speed (block-type) matte cutter (Fig. 16-38): Two blocks of hard steel: *Lower block* contains: a matte die; four registration pins; four guide posts. *Upper block* contains a matte punch; four bushings; Mitchell emblem. The upper block is attached to lower block by two spring-loaded screws secured through holes in lower block to the bar below the matte die. Guide posts of lower block ride in four bushings of the upper block to assure alignment of the punch and die.

To use:

1. Mark two frames: the one in front of and the one in back of the frame intended for use. 2. Hold the cutter with the emblem right-side up. Insert the film vertically between the upper and lower blocks.

NOTE: Negative: film emulsion should face the user. Print: film base should face the user.

3. Align the *top* of second sprocket perforation of the first marked frame with the top edge of the lower block. Align the *bottom* of the second perforation of the last marked frame with bottom edge of the lower block. Place film on the registration pins. 4. Place index and second fingers of both hands at the back of the lower block. Place thumbs on the spring-loaded screws. Press thumbs firmly until the registration pins touch the top block—the matte has then been cut. Release the spring-loaded screws and shake the matte out. 5. Insert the matte, upside down, into the focusing-tube matte slot, with the perforations toward the access door.

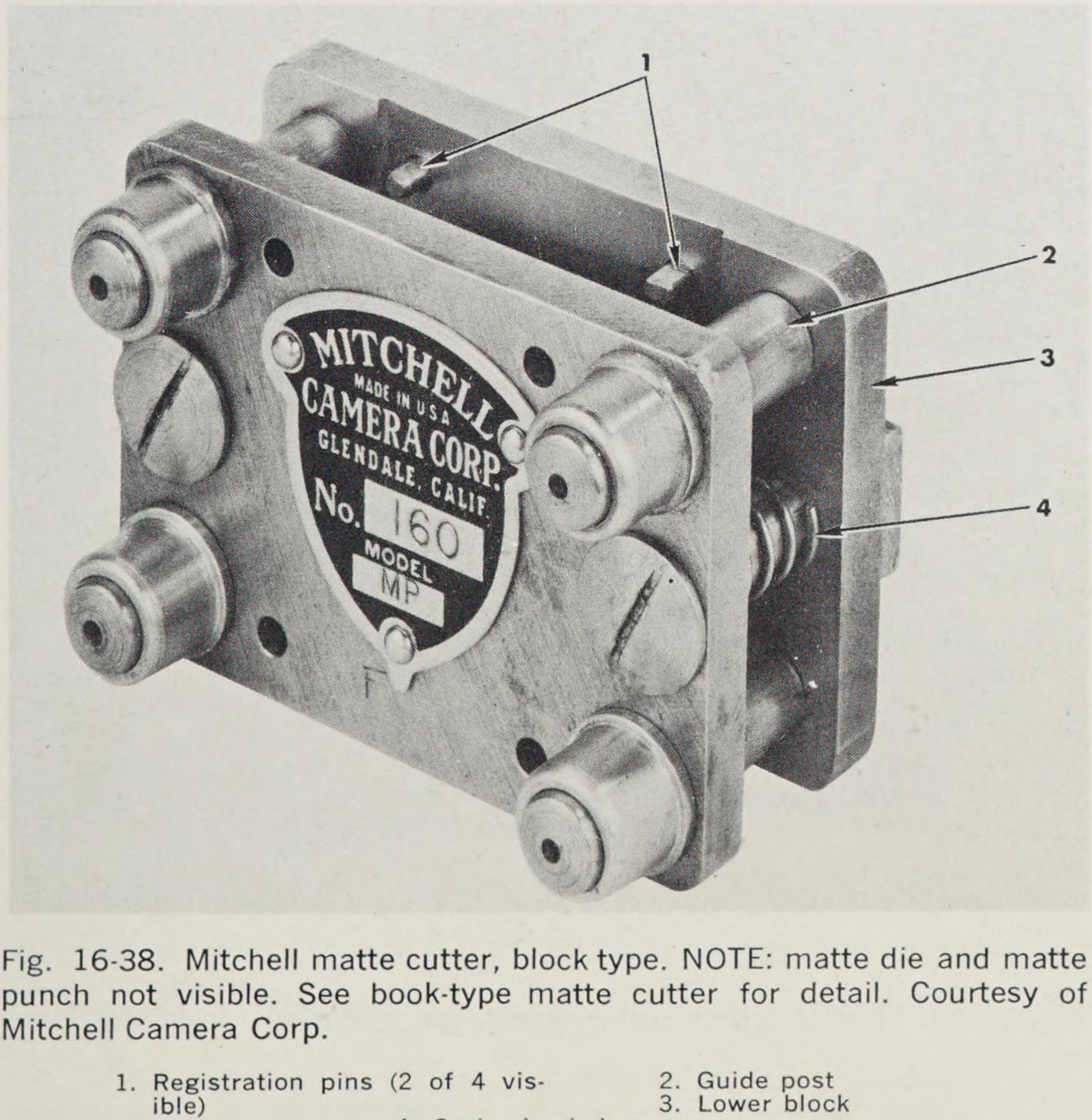


Fig. 16-38. Mitchell matte cutter, block type. NOTE: matte die and matte punch not visible. See book-type matte cutter for detail. Courtesy of Mitchell Camera Corp.

1. Registration pins (2 of 4 visible)
2. Guide post
3. Lower block
4. Spring-loaded screw

S35R (book-type) Matte Cutter (Fig. 16-39): Two pieces of hinged steel: *Lower block* contains a matte die and two registration pins. *Top block* contains the matte punch.

To use:

1. Mark two frames: the one in front of and the one in back of the frame intended for use. 2. Place hinge at left. Open the cutter and insert the film vertically onto the lower block.

NOTE: Negative: Film emulsion should face user; Print: base should face user.

3. Align the *top* of the second sprocket perforation of the leading frame with the top edge of the lower block. Align the *bottom* of the second perforation of the trailing frame with the bottom edge of the lower block. Place the film on the registration pins. 4. Close top block until the punch hits the stop—the matte has then been cut. Open top block

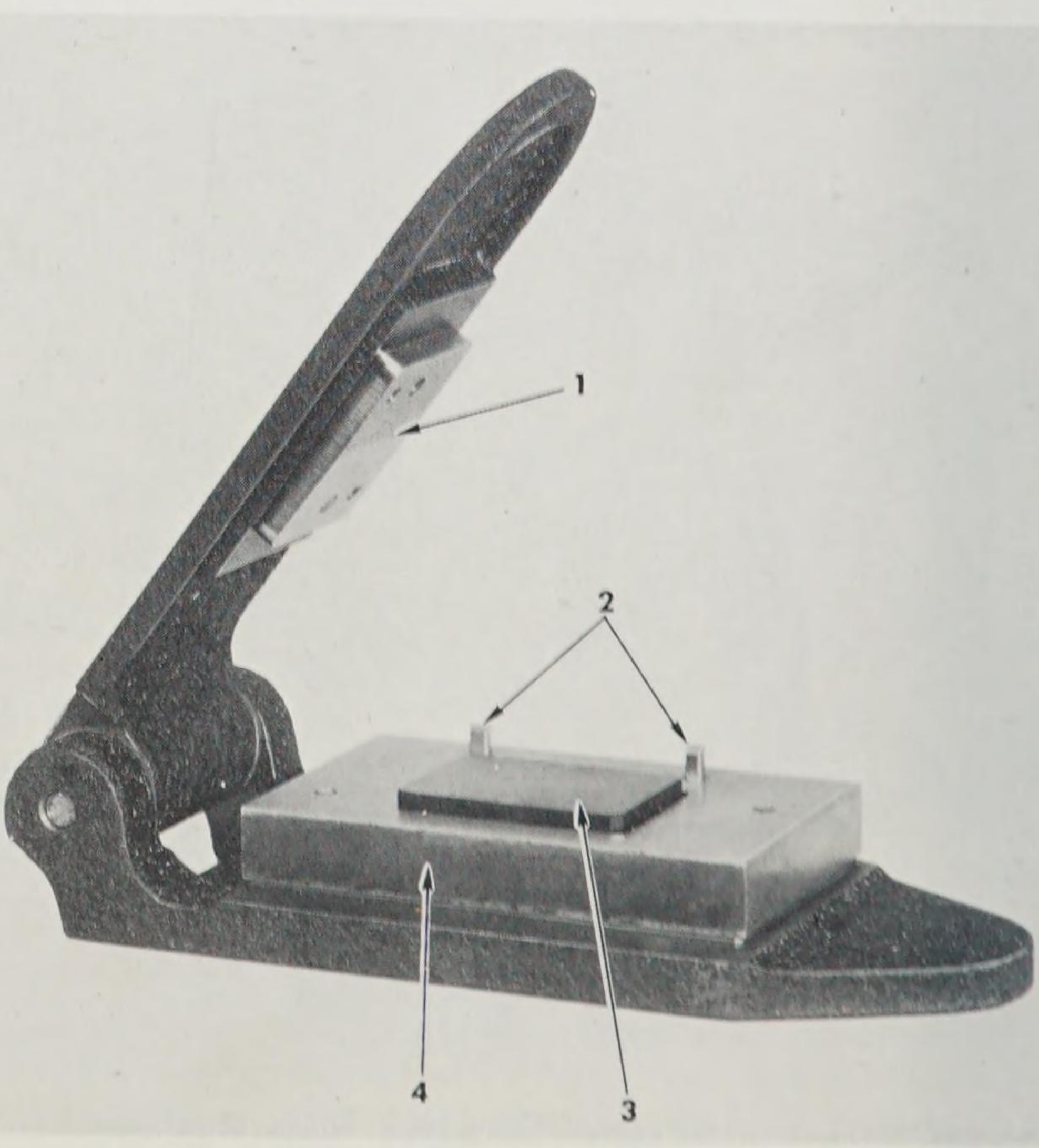


Fig. 16-39. Mitchell matte cutter, book type. Courtesy of Mitchell Camera Corp.

1. Matte punch
2. Registration pins
3. Matte die
4. Lower block

and remove the matte. 5. Insert matte, upside down, into the slot in front of groundglass, with perforations toward the turret face.

16.11e Mitchell Vari-Stroke Adjustment (Fig. 16-40)

The vari-stroke is an adjustment built into the camera movement to allow compensation for film-pitch variations and shrinkage.

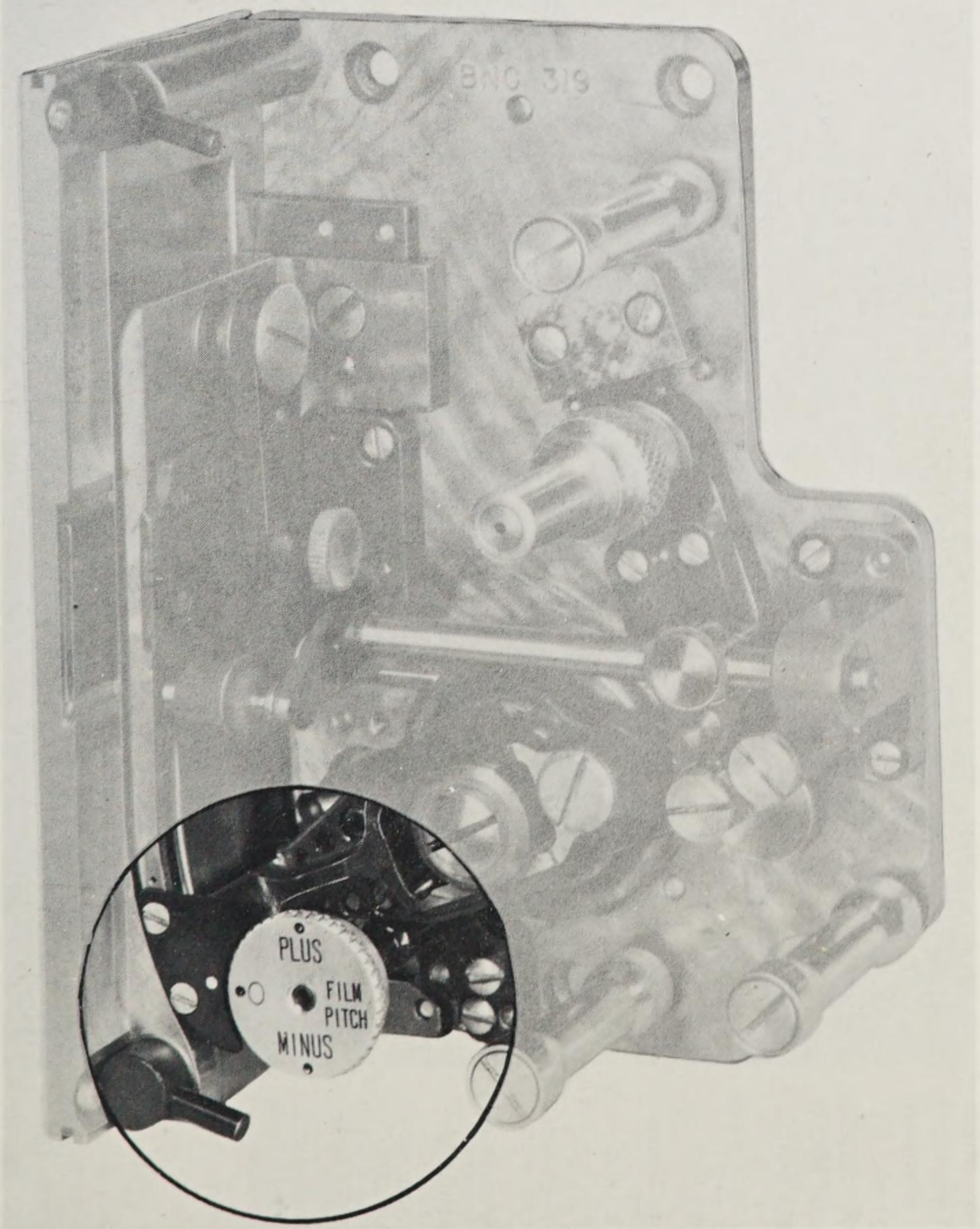


Fig. 16-40. Mitchell Vari-Stroke adjustment. Circled area = Vari-Stroke adjustment. Courtesy of Mitchell Camera Corp.

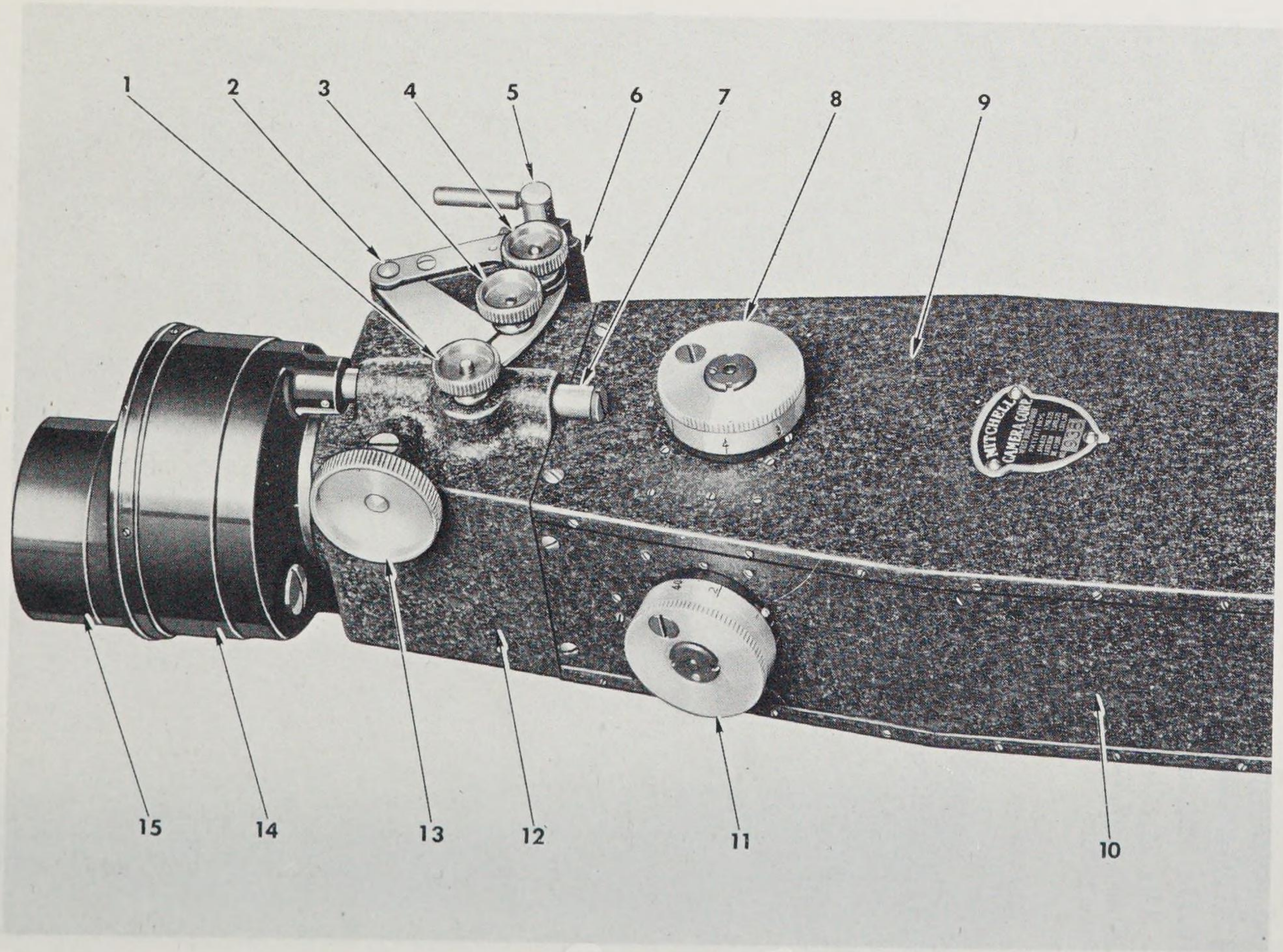
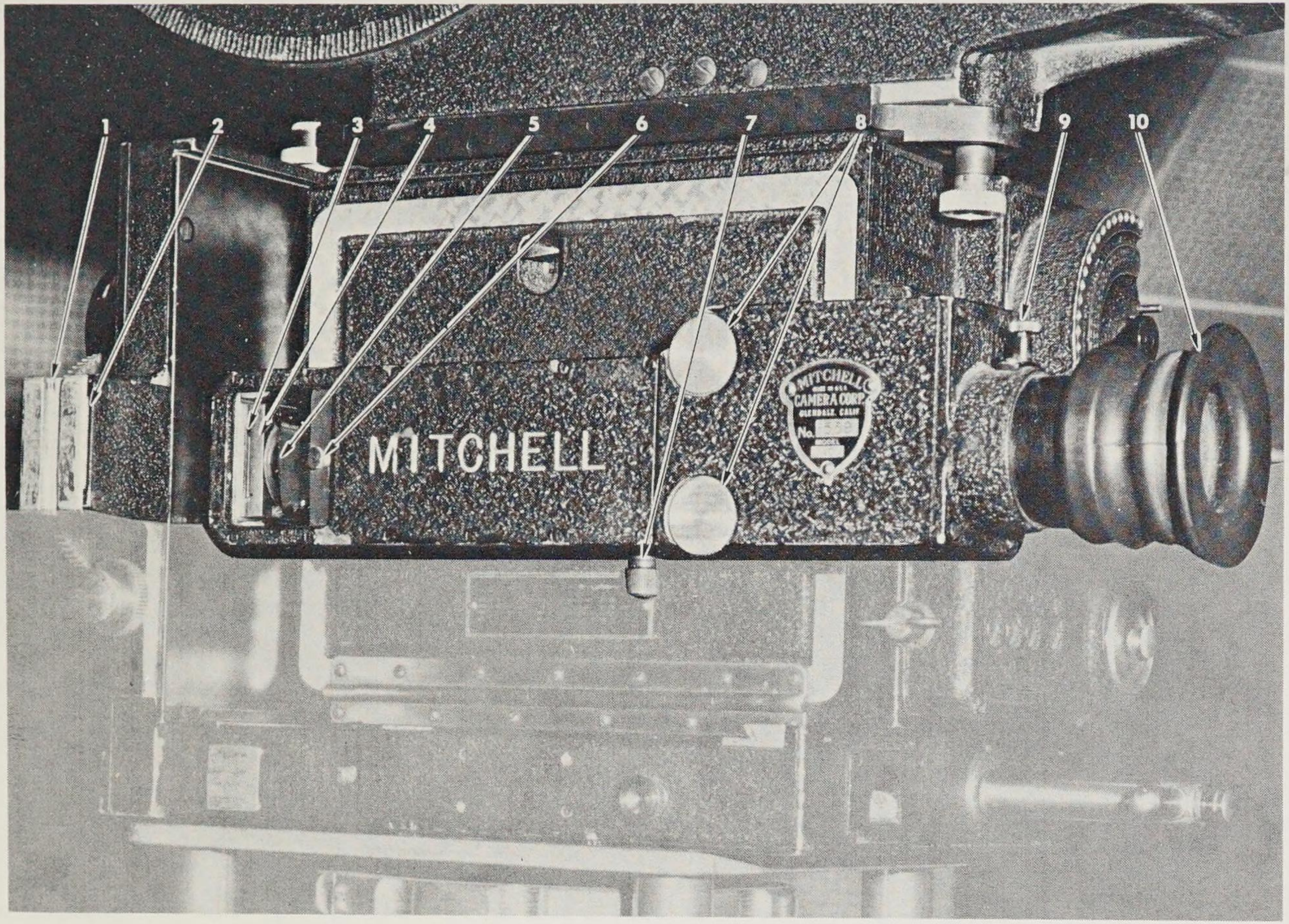


Fig. 16-41. Mitchell offset-viewfinder for Standard /High-Speed, NC, and S35R models. Courtesy of Mitchell Camera Corp.

1. Focus lock knob
2. Pivot point
3. Parallax lock knob
4. Parallax throw-out knob
5. Dovetail lock
6. Dovetail
7. Focus shaft
8. Vertical ribbon-matte adjusting knob
9. Top viewfinder plate
10. Left viewfinder wall
11. Horizontal ribbon-matte adjusting knob
12. Viewfinder nose piece
13. Focus knob
14. Prism box
15. Circular sunshade

Fig. 16-42. Mitchell focusing tube (camera racked over). Courtesy of Mitchell Camera Corp.

1. Viewfinder dovetail
2. Filter slot
3. Academy and effects matte slot
4. Groundglass
5. Focusing tube lens
6. Groundglass access door (open)
7. Magnification knob
8. Contrast filters
9. Eyepiece locking screws
10. Eyepiece



By rotating the stroke adjustment knob an eccentric shifts the claw-pivot block in relation to the registration pins, and shortens or lengthens this dimension in an effort to eliminate "picking" noise.

The stroke adjustment knob rotates clockwise ("plus") or counter-clockwise ("minus"). The direction of rotation of the adjustment knob may differ on each roll because of variations in raw stock.

Correct plus or minus stroke is determined by listening while threaded film stock is run through the camera with door open. Starting with the adjustment knob at zero, the knob may be rotated in either direction until film noise diminishes to its lowest level.

If in doubt as to noise level, leave the adjustment knob at zero (center).

NOTE: The Vari-Stroke unit is not installed in each Mitchell camera movement. It is generally found on sound models (BNC, SS-R16, etc.) or a silent model that can be blimped.

16.11f Plastic mattes for modified Mitchell viewfinders

Plastic mattes for modified Mitchell viewfinders are rectangular slides with an aperture cut out in the center. The cut-out area of the matte defines the correct top-and-bottom and side-to-side frame lines for the Camera Operator.

The size of the cutout of each matte is determined by a combination of two dimensions: a specific aspect ratio and a particular focal length (e.g., 1:85 to 1, 50mm; 1:85 to 1, 25mm; or 1:75 to 1, 100mm; 1:75 to 1, 30mm).

A number of mattes are kept together on a shower-curtain hook in "sandwich" fashion. The desired matte is swiveled out from the "sandwich" (not removed from ring) and inserted into a slot in the left side (occasionally slot is in the top of viewfinder). The matte, of course, must correspond to the taking lens.

The focal length *engraved* on each matte is inserted upright and toward Camera Operator.

Remaining mattes on the shower-curtain hook dangle from the matte which has been inserted in the viewfinder.

NOTE: Slotted viewfinders that accommodate mattes are *not* a standard Mitchell item, they have been modified.

Plastic mattes are used when a specific aspect ratio is preferred in the viewfinder (for composition purposes), while a full aperture negative is desired in the camera (e.g., filming for theatrical release at 1:85 to 1 ratio with intentions of printing from the same negative for TV at a later date).

16.11g Mitchell Offset Viewfinder (Fig. 16-41)

16.11h Mitchell Focusing Tube Detail (Fig. 16-42)

CHAPTER 17

Lenses

17.1 LENS CASES

The best lens container is a unit in which lenses "float" on sponge rubber or a similar shock-absorbent substance. When using "non-floating" felt-lined cases (fitted with holes or compartments to accommodate the lens barrels) tissue paper must be stuffed around the lens barrel, especially if the case is to be shipped. If a lens case is not available, place an unmounted lens in a black raw-stock bag and wrap enough paper around it to absorb shock.

Even when the lens is stored in a case, the front and rear lens elements must have caps for protection against dust and fingerprint smudges.

17.2 TURRET LENSES

Lenses mounted on a camera turret (except the one in use, of course) remain capped at all times. If windy or dusty conditions prevail, the front element of the "taking" lens must be protected by an optical flat or filter. (A dirt-pitted flat or filter is easier—and cheaper—to replace than a lens.)

When a lens is removed from a turret, the port must be capped or taped to keep dirt and dust from the inner turret surface.

17.3 CLEANING

To clean a lens properly, first, remove it from the turret. Angle the element to be cleaned downward. Rotate the *lens* (not the brush) so that dirt particles are shaken loose and fall down and out, rather than just being moved around as happens when the element is facing up. Use the sides of the lens brush bristles to clean the metal on the inside of the barrel and the *tip* of the brush to clean the element.

17.3a Lens tissue

To avoid scratching the fluoride coating, use lens tissue *after* the element has been *brushed* free of dirt and dust particles. *Never* put a dry tissue to a lens. The most widely used and safest cleaner is the moisture from the human breath. Liquid lens cleaner should be used sparingly (excess liquid cleaner can destroy lens-element cement).

CAUTION: Never use silicone-impregnated lens tissue (such as eye-glass-cleaning tissue)! Silicone discolors the fluoride coating.

Figure 17-1 illustrates a method of using lens tissue. (1) and (2) Roll up a sheet of lens tissue. (3) Tear into two sections. (4) Join, with shredded ends all facing one way. Squeeze one drop *only* of liquid cleaner on the end of the bundle. Use a circular motion applied with very light pressure, and check the element often for cleanliness, so that as few strokes as possible are made against the lens surface.

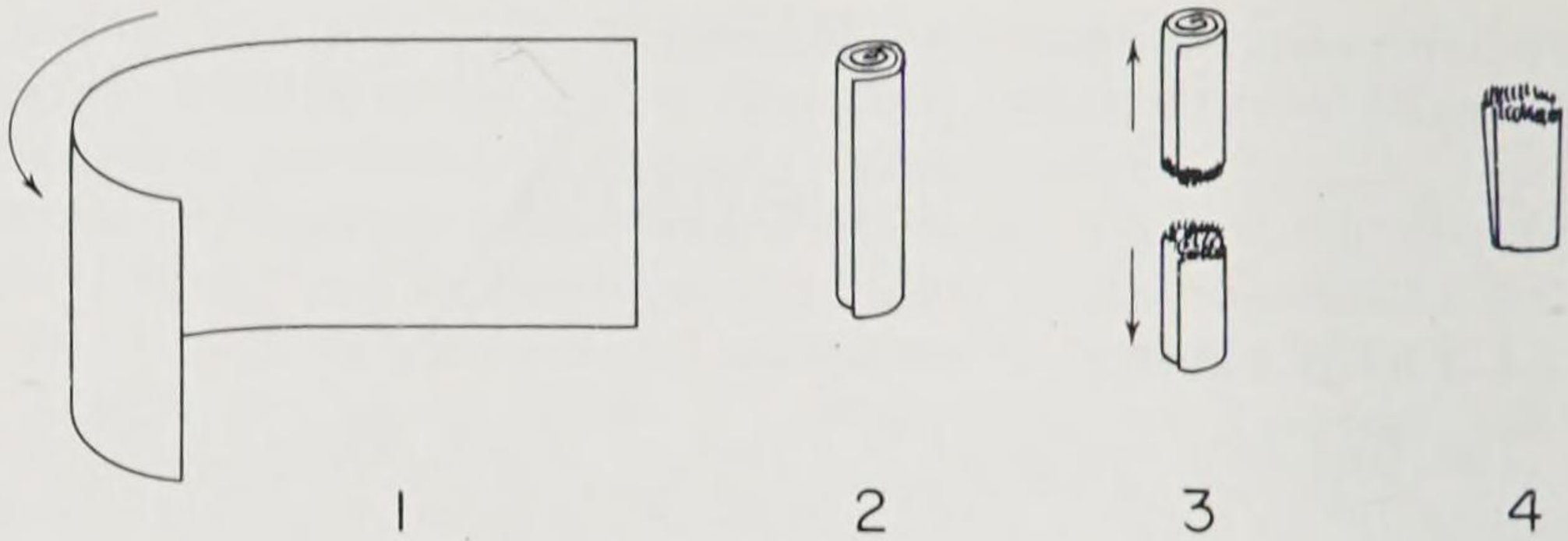


Fig. 17-1. A method for using lens tissue.

17.4 APERTURE

Check lens diaphragm often to determine that its leaves are in working order.

17.4a *f*/stops and T stops

Most older lenses are calibrated in *f*/stops, most newer lenses in T stops. Lenses calibrated in both *f*/stops and T stops are inscribed with markings—white to indicate *f*/stops, and colored (red, yellow, etc.) to indicate T stops.

When setting the diaphragm on a doubly marked lens, use the T stop markings.

17.4b To set a lens stop

1. Set the lens to its widest opening. 2. Close down to the desired stop.

For example: When an aperture of T 5.6 is called for on a T 2.3 lens, which has been stopped down to T 8: first open the lens to its maximum setting of T 2.3, then close down to T 5.6. Do not merely move the setting from T 8 to T 5.6.

This method compensates for inherent backlash in the diaphragm leaves, provides more accurate settings, and is consistent with the method used to determine the *f*/stop or T stop settings when the lens was manufactured.

17.5 WIDE-ANGLE LENSES

These "short" lenses must constantly be checked for "flare" and matte-box clearance. The rear element of a wide-angle lens should always be checked for shutter clearance by slowly rotating the manual motor-turning knob on offset viewfinder cameras (inching knob on

reflex cameras) several times after the lens has been inserted into turret. This is especially important on 16mm and 35mm cameras that have interchangeable lenses.

Never place a gelatine filter on the rear element of a wide-angle lens. Filters have been lifted off the rear element by the shutter and ground up in the camera mechanism, resulting in ruined footage and major repairs.

It is better to place a filter at the front element of a wide-angle lens, because a filter placed in a filter slot *behind* the lens, being closer to the focal plane, will register dust and dirt more readily, especially if stopped down smaller than *f*/8. If the filter is taped in place, make certain the tape holding the gelatine or glass filter is clear of the front element.

The 2 × 2 in. glass filter used in extreme-wide-angle lenses (5.7mm, 9.8mm) should have *rounded corners*. Filters with squared corners have no "leeway" and may crack or shatter from the pressure exerted by the filter lock when secured, or if the camera is jarred.

Neutral-density filters—most commonly used: 0.30 (one stop); 0.60 (two stops); 0.90 (3 stops)—should be part of a lens kit, since most wide-angle lenses will "vignette" if stopped down smaller than *f*/8.

17.6 TELEPHOTO LENSES

Lenses 125–2000mm require a supporting cradle when mounted to a camera.

Filters for telephoto lenses should always be placed at, or as close as possible to, the rear element. Make certain that a tape holding a gelatine filter in place is clear of the rear element.

On lenses fitted with filter holders, a gelatine filter is better than a glass—there is less aberration, due to the thinner material.

Skylight or ultraviolet filters (most commonly used are: skylight: 1A, 2A; and UV: 15, 16) should be part of a lens kit, since telephoto lenses suffer image deterioration due to haze, heat waves, etc.

Temperature changes cause expansion or contraction of lens components, therefore check focus just prior to filming.

Tripod and camera must be rigidly secured with a tie-down chain to avoid sway or vibration. Vibration can only be detected by sighting through the lens with the viewing tube set at maximum magnification and with the *camera motor running*.

17.7 FOCUS

Always remove the lens to focus the camera eyepiece. Aim the empty lens port at a medium-bright area. Adjust the eyepiece until the cross hair or granular surface of the groundglass is sharp.

If a tape measurement varies from a groundglass measurement, rely on the groundglass focus (providing the eyepiece has been adjusted as described above, and not with the lens in place). If in doubt, shoot a few feet of film focused at both measurements and conduct a hand test (Sec. 3.10).

Where focus change is extremely critical (especially with long focal-length or telephoto lenses), select a number of intermediate reference points between a beginning and an end focus. Measure off each intermediate focus point and transcribe each measurement to either a strip of tape over the footage indicator on the lens or to the follow-focus disc. As the subject moves to each reference point, match the respective distance on the lens (or disc). If the subject is stationary, but the camera moves, place intermediate reference points on the floor. While this procedure is time-consuming, the greater accuracy of focus is worth it. Where possible, hook a tape measure to the subject and let a Second Assistant call off footage as he reels the tape in or out.

When a new lens is brought up on the turret, always set focus at the approximate camera-to-subject distance so that the Operator and/or First Cameraman can see a reasonably sharp scene and concentrate on composition and lighting.

A word of caution regarding matte boxes (or filter holders as found in some blimps): When a focus change from a *far* subject to a close subject is necessary, it is well to remember that the shorter the distance from film plane to subject, the longer the lens barrel extends from the mount. Therefore, the matte box (or filter holder) must be positioned on the rods when the lens is at its longest extension, *i.e.*, focused on the close subject. Otherwise, the *f*/stop ring on the end of the lens barrel will come in contact with the matte box (or the glass filter) and be moved inadvertently as the lens rotates from far to near focus, resulting in an underexposed shot.

17.7a Split focus

While depth of field varies greatly depending on focal length, aperture, and focus setting, a rule of thumb is that the depth of field extends approximately one-third from the plane of focus to its nearest limit, and two-thirds from the plane of focus to its farthest limit. Therefore, instead of splitting the focus equidistant between two subjects, "pull" the focus closer to (but still beyond) the near subject so as to carry both subjects in sharp focus.

17.7b Extreme close-up with normal lens

To use a lens closer than its normal minimum focal point (on a reflex camera, or a camera fitted with a focusing tube), the lens is released from its mount and extended toward the subject.

Extension of a C-mount lens: Accomplished by unscrewing the lens from the port far enough to achieve the desired focus, but not far enough to remove the lens entirely. This extension procedure is limited by the number of threads on the lens.

Extension of a bayonet base lens: Accomplished by releasing the lens from the turret, and extending it from the port to achieve the desired focus. To maintain stability and focus, scrap film is broken into small pieces, and these film "chips" are wedged between the turret and shoulder of the bayonet base.

Extension of a Mitchell Baltar lens: Accomplished by unscrewing the lens from the mount; if additional extension is needed, the mount itself can be extended to the length of the screws holding the mount to the turret. When extension is achieved, film "chips" are wedged in the top area first, then "filled in" at the bottom area between the shoulder of the mount and the turret, to give the lens stability and maintain focus.

NOTE: When a lens is extended from the normal position and held by hand to determine focus it is said to be "at air rest." When a lens is wedged in place with film it is said to be "at chip rest."

CAUTION: When extending a lens from its normal position on the turret, always sling a net or blanket below the turret to catch a dropped lens.

17.8 VARIFOCAL (ZOOM) LENSES

Never mount a zoom lens without a support.

There are two types of lens supports: (1) the boom (overhang), and (2) the cradle.

Boom: A one-piece assembly that clamps the lens from above and mounts to the camera matte-box shoe or matte-box mounting pin. Located above the turret, it is nonadjustable.

Cradle: An adjustable unit that mounts on matte-box rods located below the turret. The cradle provides a solid rest *beneath* the lens barrel and allows the lens to be adjusted in any direction (left, right, up, or down).

NOTE: Although the lens lock on the Mitchell BNC is sufficient to keep the Som Berthiot 38–150mm zoom lens rigid without additional support, the 24–240mm and the 25–250mm Angenieux zoom lenses require support at all times to alleviate strain on the lens mount at the turret port, as well as on the entire optical system.

17.8a Mounting zoom lenses

Assemble the cradle and attach to the camera, then sit down holding the camera in your lap (when feasible), turret *up*. Mate the lens to the turret port, letting the lens seat itself in the mount. Adjust the cradle to the lens. Only then is the camera mounted to the tripod head.

This method has two advantages: the lens rests properly against the turret port face; and the cradle support is adjusted to the lens with no strain on the turret.

With cameras employing top-mounted boom supports (e.g., Arriflex), this method must be used so that the support can be secured with the lens in a vertical position. This prevents sag which would warp the turret and cause damage to the camera. Lens sag also throws the lens out of alignment with the film plane and results in loss of definition in the wide-angle aspect of the zoom move.

When the "lap method" is not possible because of the size of the camera, insert lens into the turret port and press lens against the turret port face. Never let the lens rest in the turret unsupported! While still

maintaining pressure with one hand against the port face, adjust the cradle with the other hand, or get help from another crew member to secure the lens.

NOTE: It is important to remember that no matter which method is employed, the various adjusting screws and knobs of the support cradle are always loosened before mounting the lens. The cradle or support is then made to conform to the lens, never vice versa.

It is extremely important that the zoom lens be securely attached to the camera when making angled-down shots since the weight of the lens can pull against the turret and throw the shot out of focus.

After the assembled lens and camera are placed on the tripod, the various steps necessary to align the internal tracking of the lens begins.

NOTE: A zoom lens may be adjusted internally by certain expert optical or camera-repair firms to track perfectly for a particular camera. On rented equipment, of course, this is not always possible, although it may be requested of the rental agency. Time and expense must be allowed for this adjustment.

17.8b Tracking

Varifocal lenses have an inherent side drift when zoomed. This can be minimized by mounting the lens on an adjustable cradle. Each time the lens is mounted, the same procedure must be followed. After mounting, set the lens at its longest focal length, footage scale at infinity, and aperture at its widest opening. Align the cross hairs (horizontal and vertical) with an object at infinity through the camera optical system (reflex or focusing-tube). Slowly zoom to the shortest focal length. Correct any shift of the cross hair from the object by moving the adjustable barrel rest in the opposite direction of the shift. For example, if, on its longest focal length, the horizontal cross hair corresponds to a horizontal object at infinity but shifts below the object when zoomed to its shortest focal length, elevate the adjustable lens-rest half the distance of the cross-hair shift. Zoom in, realign the cross hair with the object, and repeat the procedure until minimum shift remains. If the horizontal cross hair rises above the object, lower the adjustable lens-rest half the distance, readjust the cross hair, etc.

If the vertical cross hair corresponds to a vertical object at infinity but shifts to the left when zoomed back, slide the barrel rest to the right, half the distance of the shift. If it shifts to the right, slide the barrel rest to the left, half the distance; realign, etc.

Until cross-hair shift is minimized, small adjustments and frequent zooms to check progress are better than large adjustments.

Care must be taken that the entire framing is in sharp focus: too much adjustment can throw one side of the frame out of focus.

17.8c Focus shift

If a lens that is in sharp focus on a long focal length softens when zoomed to a short focal length (or vice versa), remove the lens and reseat the unit in another turret port. Sometimes a slight rotation of

the lens in the port will eliminate a focus problem due to faulty seating. A slight cradle adjustment (left, right, up, or down) may seat the lens better.

If a series of corrective attempts fail to eliminate the problem, retire the lens until it can be bench-checked.

17.8d Offset–viewing-tube mismatch

On 35mm nonreflex zoom lenses it is not uncommon to discover that the offset–viewing-tube cross hair and field scribe do not match the cross hair and field scribe as viewed through the racked-over camera. This could be due to improper seating of the groundglass. More likely, however, it is the result of improper locking of the viewing tube on the lens. Loosen the tube and retighten.

If this fails to correct the problem, zoom the lens to its longest focal length; set the footage scale to infinity and the aperture at its widest opening. Align the cross hair, as viewed through the racked-over camera, on an object at infinity. Compare the offset viewing-tube cross hair to the camera cross hair. Remove the cover plate in the viewing-tube elbow.

CAUTION: The five screws are tiny and can be easily lost!

Reveal the prism held in place by one prism lock (a small piece of brass wedged in recessed slots, with a center screw holding the prism in place). Relieve the screw on the lock slightly; compare cross hairs of the camera and viewing-tube optics once more before adjustment.

Align the vertical cross hair by a very slight shift of the prism, left or right; align the field scribe by rotating the prism on its axis to match the viewing-tube field with the camera field. Alignment complete, tighten the locks firmly and compare the cross hairs and field again. (Tightening the screw can shift the prism out of alignment and the procedure must be repeated with allowances for prism shift with the renewed adjustments.)

Adjustments of the horizontal cross hair that cannot be taken up in the elevation or depression by wedging with strips of paper require an optical bench correction.

Replace the elbow cover.

> NOTE: Adjustment of the prism is a delicate and critical procedure requiring time, patience, and persistence. It is best done on an optical bench by a technician, preferably before the camera is sent to the photographic site.

To ascertain the alignment of an offset–viewing-tube 16mm zoom lens in a nonreflex camera: zoom the lens to its longest focal length; set the footage scale to infinity and aperture at its widest opening. Align the viewing tube field with an object at infinity. Remove the offset viewing tube. Open the camera door. Open the camera gate, insert a focusing prism into the gate, and sight through the camera aperture. Check the side lines, top, bottom, and center to verify their positions. Compare the alignment; slowly zoom out; check the framing; replace

the offset viewing tube and compare the side lines, top, bottom, and center.

Nothing can be done on the job to correct variance of a 16mm offset viewing tube except to inform the Operator and ask him to compensate for it. Correction is a bench job.

17.8e Hand-zooming

On nonmotorized varifocal lenses, the Assistant is required to zoom and change focus by hand. Smooth moves, proper focusing, and correct image sizes may be enhanced by applying the following methods.

Smooth moves: The zoom dampening lever may have a tendency to "hang up" or "slip" momentarily, creating a "jump" in the field as the image changes. With very slow, almost imperceptible, zooms, the lever can be grasped with both hands, and while one hand moves the lever in the direction of the zoom, the other hand resists, enabling the "hang-up" or "slip" to be passed over smoothly. If a focus change is required at the same time, however, the attachment of a rubber band, one end looped around the lever, the other end looped around some part of the cradle, provides resistance to the direction of the zoom. Proper tension of the band (by doubling or tripling it, depending on the elasticity and amount of tension desired) depends on the desired speed of the zoom. Remember, do not release the lever at the end of the zoom until the shot is completed, or the resistance of the rubber band will return the focal-length setting to its starting point and spoil the shot.

Zooming: Covering the entire focal range (long to short, or vice versa) by hand affords little problem when doing the zooming, but stopping short at a desired focal length demands greater accuracy. In a situation where a zoom and focus change are rapid or differ in speed, coming to a halt on the exact setting desired is not as simple as it sounds. The problem of an over- or undersized field can be eliminated by using a piece of camera tape as a stop. On a radial (rotating barrel) lens, set the desired *final* focal setting to the barrel witness mark. Wrap one end of a length of camera tape around the focal-length ring and the other end (called the "anchor" of the tape) around the cradle. Set the lens to the *starting* focal length and allow the excess tape to hang loose between the lens and cradle. When the lens is zoomed to the desired final focal length, the tape becomes taut and stops the rotation of the focal-length ring. The person zooming can concentrate on smoothness of movement and focus and not miss the end of the zoom.

On a linear (push–pull-type lever) lens, the camera tape is wound around the focal-length *lever*, anchored to the cradle, and the same procedure followed.

For extremely fast zooms, set the starting focal length, grasp the ends of a length of camera tape in both hands, and apply the adhesive side to the focal-length ring. Be sure that the tape forms a sideways

U around the ring. On cue, quickly rotate the ring by pulling the tape until the final focal length is reached.

For extremely slow zooms, secure a dowel or metal rod with camera tape or Gaffer's tape to the focal-length lever and apply light pressure to the end of the dowel or rod. The longer the lever extension, the slower and smoother the zoom will be.

17.9 ZOOM-LENS ACCESSORIES

17.9a Zoom motors

Zoom-motor types and their manufacturers are far too numerous to list. Basically a unit consists of three components: (1) motor drive; (2) rheostat; (3) power pack.

Motor drive: Size varies according to the lens for which it is intended. Depending on the manufacturer, it may be positioned on the lens at the top, bottom, or side of the barrel. Bidirectional. A slip clutch ensures smooth starts and stops.

Two adjustable stop rings allow specific zoom ranges to be preset.

On a radial zoom lens, a geared ring is usually pressure-fitted over the focal-length barrel, or clamped with hex screws. The motor-drive shaft is geared. To check the unit, set the focal-length indicator on the barrel at its maximum (longest) focal length, and the drive-selector switch at optimum "in" position. Fit the geared end of the drive shaft to the geared ring on the barrel and lock it in place. Operate the drive to determine if the full focal range can be reached. If it cannot, the drive was not set at maximum "in" and the unit must be readjusted.

> NOTE: Some 16mm zooms use a plastic pressure band coupled to the motor instead of a geared ring around the barrel.

On a linear zoom lens, the motor drive is usually side-slung. The focal-length lever fits between two projecting rods connected to the drive shaft with a slip clutch. To check the unit, set the focal length at its maximum (longest), and the drive at optimum "in" position. Focal range is checked out as above.

> NOTE: If the drive motor operates but does not change the focal length, the drive unit is either at the wrong position ("out" instead of "in") or it is clamped too tightly to the geared ring or focal-length lever.

If, during a zoom movement, the ring slips or the image "hangs up" or "jumps" momentarily, the drive unit is too loose and requires tightening. A prerequisite for smooth zooms is fine adjustment of all movable parts and a rheostat in good condition.

Rheostat: Depending on the manufacturer, the unit may be attached to the motor drive or housed in a separate unit, or may have a forward–reverse switch attached or housed in a separate unit and connected with cables. Turning the speed-selector switch clockwise increases the rate of zoom speed, turning it counterclockwise decreases it. Duration of a zoom must be determined by a stopwatch. The speed selector

may be numbered, but numbering is not standard. Numbers are only good for reference in setting of zoom speeds; they are not consistent because speeds may vary depending upon the state of the power pack.

Power pack: Battery power. Size varies depending upon motor drive (from single flashlight cell up to 24 volts). Improper voltage, either high or low, can burn out a motor drive, so it is imperative that proper voltage be determined and maintained.

17.9b Zoom-lens retaining rings

Used to mount circular glass filters or diopters (see Sec. 17.9d) to the front element of a zoom lens.

To remove: Because zoom-lens retaining rings are very large and extremely thin-walled, grasping them around the circumference with the fingers exerts pressure which deforms the rings in the threads, thereby further impacting the rings. Merely *pinching* the ring with thumb and forefinger *at only one point* on the edge of the ring, *then* rotating the fingers, can generally free the impacted ring.

NOTE: Extremely tight rings may need a few drops of solvent in the thread channels to loosen. In the absence of solvent, a popular cola soft drink may be used. The soft drink has also been found useful for removing rusted and paint-frozen screws on equipment.)

CAUTION: The cola will remove paint from camera surfaces unless removed immediately!

17.9c Filters and sizes

17.9d Zoom diopter lenses

Supplemental meniscus lenses permit close-up cinematography by allowing the zoom lens to be used at a distance shorter than the minimum footage incorporated in the original design. Thus while most varifocal lenses cannot be focused at less than 5 or 6 ft the addition of a diopter lens or lenses enables the zoom lens to be focused as close as 4 in. without the need for extension tubes.

With a diopter lens attached, the footage indicator on the zoom lens must be converted. While tables are given for mathematical computation of subject distance to lens, lens manufacturers caution that such data are approximate. Therefore a groundglass focus (which is also quicker) is more accurate than the tables.

Most diopters are fitted with metal rims in which an etched arrow points toward the subject. Lenses without the arrow should be mounted with the "bulge" of the lens toward the subject.

When mounting lenses in combination, place the more powerful lens closest to the camera lens.

No exposure compensation is necessary when the lens or lenses are added.

When a particular diopter lens is called for, Table 17.2 will provide a rough rule of thumb as to the distances a camera can be set from the subject and maintain focus. Conversely, if the camera must remain in one position, the table indicates which supplementary lens will provide the focus desired.

TABLE 17-1

ZOOM LENS FILTER SIZES

Manufacturer	35mm	16mm	Focal Range	Front Filter Size*
Angenieux	x		24–240mm	none†
	x		25–250mm	4½" or 119mm
	x		35–140mm	Series 8
		x	9.5–95mm	4½" or 103.5mm
		x	12–120mm	Series 9
		x	12–240mm	4½" or 107mm
		x	12.5–75mm	Series 8
		x	17–68mm	Series 7
		x	17.5–70mm	Series 7
SOM Berthiot	x		38–154mm	3" or Series 8½
(Pan Cinor)		x	17–85mm	Series 8
		x	17.5–70mm	Series 8
		x	25–100mm	Series 8
Century Precision Optics		x	12–100mm	Series 7
		x	20–200mm	Series 9
Elgeet		x	20–80mm	Series 8
Kern Paillard		x	18–86mm	Series 8
Canon		x	25–100mm	Series 8
Schneider		x	16–60mm	Series 8
		x	16–80mm	Series 8
Zeiss		x	12.5–75mm	Series 9 (or 3" x 3" filter when lens is fitted with a front holder)

*Front filter size is also the size of the diopter lens for extreme close-up photography.

†Fitted with an offset viewfinder; made special for the Mitchell BNC.

TABLE 17-2

ZOOM DIOPTER-LENS RANGES

Diopter	Range (inches)
+½	39–79
+1	20–39
+2	13–20
+3	10–13
+4 (+3 and +1)	8–10
+5 (+3 and +2)	6½–8
+6 (+3 and +3)	5½–6½
+7	5–5½
+8	4½–5
+9	4–4½
+10	4 inches only

Once focus is within the diopter range, a slight focus adjustment or movement of the camera will determine the exact measurement.

Glossary

Boom: An extension piece used to support a matte box or, on some cameras, to support a lens from above the turret.

Buckle-trip: A spring-actuated circuit breaker that cuts power to the camera.

Cam: (Camera). See eccentric.

Cam: (Viewfinder). A flat metal piece used to guide a roller so that the viewfinder parallax is always coincident with the focus of the camera lens.

Cannon plug: A multiple-contact connector, tubular-shaped, fitted with a guide-key to ensure correct mating of contacts, and equipped with either a spring-lock on the receptacle or a threaded nut and collar on the plug shaft to hold the plug securely to the receptacle.

Connector: A coupling device, consisting of a plug and receptacle, that provides an electrical junction between two cables, or between a cable and camera, etc. (See also Plug and Receptacle.)

Cradle: A device used to support the weight of a heavy lens and relieve the turret of that extra weight.

Dog: A gripping device consisting of a rod or bar attached to the magazine lid lock or door lock. When the magazine lid (or door) lock is turned to *Close* the "fang" at the end of the rod or bar engages the lug (see Lug) of the magazine or camera body and secures it to the larger unit.

Eccentric: A mechanical device consisting of a disc having its axis of revolution located elsewhere than at the geometrical center, which, when rotated causes an attached registration pin and/or pulldown claw to obtain a reciprocating motion from a circular one.

Flange: A projecting rim, or rib, which gives a unit additional strength.

Gib: A wedge-shaped piece of metal that holds the camera box to the base, yet permits the camera to slide laterally.

Governor: An attachment for controlling motor so that it runs at a constant rate of speed.

Handgrip: An integral piece of the equipment grasped by the hand when carrying or filming with a unit.

Hex-head: A hexagon (six-sided) head shaped screw or bolt.

Holddown: A screw which secures in place any integral part of the camera which may have to be frequently removed (such as a magazine which is secured to a camera by a holddown screw). As opposed to *lockdown* screw (although the terms are used interchangeably).

Housing: An enclosure on a camera or part thereof which sound-proofs, or protects the user from, the moving parts.

Intermittent movement: The assembly consisting of the cams, gears, pins, claws, and shutter, which work in concert to control the movement of film.

Jack: A female socket into which a plug is inserted. As opposed to a receptacle, a jack usually accepts a single pin and is DC, while a receptacle is usually multi-pin and AC.

Knurled: Covered with small protuberances to facilitate a better grip by the fingers (as opposed to milled).

Lug: A short flange which engages a dog "fang" to secure a magazine lid or camera door.

Lockdown: A screw which secures an integral part of the camera which is not frequently moved. As opposed to *holddown* although the terms are used interchangeably.

Lock nut: A secondary nut used with a primary nut on a screw or bolt to prevent the primary nut from turning.

Locating pin: A short rod or stud projecting from an accessory which, when aligned with the camera pilot holes places the accessory in proper position for mounting. As opposed to positioning stud, although the terms are used interchangeably.

Milled: Ridges or corrugations on the edge of a screw head.

Phenolic gear: A toothed wheel molded of plastic with a phenol resin base. It is of high mechanical strength, high electrical resistance, and water and acid resistant.

Phillips head: A screw head with a cross slot; requires a special screwdriver.

Pilot hole: An opening that accepts a locating pin or positioning stud.

Plug: The movable half of a connector attached to a cable, and which is inserted into a receptacle.

Polarity: The correct negative and/or positive terminal of two opposing directions of current flow.

Positioning stud: A short rod fixed in and projecting from a camera (as opposd to a locating pin which is on an *accessory*). Used as an assist in the alignment of another piece of equipment being mounted.

Rack: A bar with teeth on one edge, and positioned on the bottom of the camera box. The teeth engage a gear in the camera base. When the gear is rotated (by a rackover handle) the camera box moves to one side.

Registration pin: A shaft that holds a film frame in position behind the aperture as the frame is being exposed.

Rheostat: A variable resistor.

Ring: A hoop of metal.

Rocker switch: A type of switch pivoted in the middle so that it "rocks" when turned to "ON" or "OFF" position.

Scribed: Etched (usually in glass).

Snug fit: The closest fit that can be assembled by hand.

Spindle: A slender rod on which a core holder or a wheel turns.

Swivel: A pin and collar which permits circular motion of a component (e.g., the turret).

Tapped hole: A hole that has internal screw threads.

Toe: The pointed extremity of a magazine.

Toggle switch: A type of switch having a small projecting lever.

Travel: The restricted distance and/or course a part can be moved.

Tuchel connector: A miniature connector in which the plug half is fitted with a sleeve that acts as a coupling nut to secure the plug to the receptacle.

Vernier: A small auxiliary focusing knob used with a larger focus knob to obtain fine adjustment.